THE EFFECT OF VARIOUS N RATES AND LEGUME COVER CROPS ON MAIZE YIELDS AND EROSION

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN AGRONOMY AND SOIL SCIENCE

DECEMBER 1981

By

Larry Kenji Shinshiro

Thesis Committee:

Samir El-Swaify, Chairman
Peter Rotar
Duane Bartholomew
Robert Joy

We certify that we have read this thesis and that in our opinion it is satisfactory in scope and quality as a thesis for the degree of Master of Science in Agronomy and Soil Science.

THESIS COMMITTEE

Samir A. El-Swaify

Chairman

Peter P. Rotar

Robert J. Joy

Duane Bartholomew

ACKNOWLEDGEMENTS

I would like to thank Mr. Andrew Lo and Mr. Wang Yu Ki for assisting with the computer programming and chemical analysis. I also appreciate the opportunity provided by the USDA Soil Conservation Service in granting an educational leave during the period of this study, and for providing a location for conducting field investigations at the Plant Materials Center.

TABLE OF CONTENTS

Page

LIST OF TABLES

Table		Page

Table		Page

LIST OF ILLUSTRATIONS

INTRODUCTION

The world's arable lands cover approximately six billion hectares, all needing some type of protection from erosion (Stout, 1965). Soil scientists estimate that the annual tolerable soil loss must be limited to less than 12.5 tons per hectare in deep soils, and 2.5 tons per hectare in shallow soils. Common observations, as well as results of research, indicate that a reduction in crop yields occurs when the "top soil" is removed. For instance, subsoil plots needed an additional 16 to 23 kilograms of nitrogen fertilizer to produce maize (Zea mays L.) grain yields comparable to the control (topsoil) plots (Engelstad and Shrader, 1961). Many similar results have been reported for various crops, but few such experiments have been conducted in the tropics (El-Swaify et al., 1981).

The Universal Soil Loss Equation (USLE) is widely used in the United States to plan soil conservation measures with the intent of keeping soil losses to a tolerable level (Wischmeier and Smith, 1978). The majority of the field data required for using the USLE was collected from areas east of the Rocky Mountains. Recently, El-Swaify (1977) showed that the values and parameters of the USLE that are true for some regions do not necessarily apply to other areas. It was shown that the parameters to predict erodibility of the soil for temperate conditions cannot be successfully used on Hawaiian soils. El-Swaify et al. (1981) also found a different relationship between soil loss and slope gradient for some Hawaiian soils. They also reported that exponents for the USLE slope and length factor may underestimate the soil losses on some Hawaiian soils.

Aside from the soil erodibility factors obtained by simulated rainfall (Dangler et al., 1976), there is a lack of quantitative values for the factors of the USLE under Hawaiian conditions. Current research efforts are directed towards obtaining such quantitative values at various locations in Hawaii (personal communication, El-Swaify, January 1980).

The purpose of this study was to obtain quantitative information on the following objectives:

1. Effect of nitrogen fertilization rates, and legume intercropping with rose clover (Trifolium hirtum All.) and 'kalo' (Lotus corniculatus var. arvensis Pers.) on maize grain and stover yields on a tropical Aridisol.

2. Effects of nitrogen fertilization rates, vegetative cover, and intercropped legumes on water and soil losses associated with runoff.

LITERATURE REVIEW

Effects of Cover on Runoff and Soil Loss

Runoff and soil loss due to rainfall are products of many interrelated factors: rainfall erosivity, soil erodibility, topography, conservation practices, vegetative cover, and management (Wischmeier and Smith, 1978). The soil erosion process is initiated after detachment of soil particles by raindrops. These detached particles are then transported with the surface runoff. Screenivas et al. (1947), among others, discovered that the detachment of soil particles decreased with increasing cover. Soil conservation practices that reduce a raindrop's energy and maintain a high infiltration rate will subsequently decrease runoff and soil erosion.

The inherent characteristics of vegetation, and its appropriate management practices can greatly reduce soil erosion. Siddoway and Barnett (1976) stated that multiple cropping systems can reduce soil loss as:

> "Vegetative cover is the most important faction in erosion control and is intimately related to cropping systems."

Baver (1956) listed the major benefits of vegetation in erosion control as:

1. Interception of rainfall
2. Decrease in runoff velocity

3. Increase in soil granulation and porosity
4. Transpiration of water
5. Enhancement of biological activities associated with vegetation and its influence on porosity
6. Increased infiltration.

The Universal Soil Loss Equation (Wischmeier and Smith, 1978) contains the important parameters of soil loss. Hudson (1971) lists three factors of the USLE that can be easily manipulated: L, slope length; P, conservation practices; and C, the cover and management factor. Usually, L will have values ranging from 1.0-3.0; P, values between 0.3-1.0. Realistically, the manipulation of the L and P factors can reduce soil losses by 70%. Soil losses can be further reduced by imposing the proper C factor. The values of C can range from 0.05-1.0; by proper manipulation, the soil losses can be reduced by 95%. Vegetative cover, which provides the basis for biological soil erosion control, has the distinctive advantage of requiring lower capital cost to the farmer than land shaping and structural measures, which provide the basis for mechanical or engineering controls.

Evidence abounds that runoff and soil losses are dependent upon the cover over a soil. Numerous researchers have reported an increase in infiltration rates due to the increase in vegetative cover (Bertoni et al., 1958; Buetner et al., 1940; Horner and Lloyd, 1940; Borst et al., 1945). In Africa, Hudson (1957) demonstrated the importance of cover by using mosquito netting to simulate a full vegetative canopy. A plot of bare ferallitic sandy clay loam soil lost an average of 127 times more soil than a plot covered by the netting. Losses from a plot with complete grass cover were similar to the netted plot, indicating that roots and stems were of secondary importance in controlling erosion. The bare plot's runoff was 13 times greater than the netted plot.

Aside from the above-described "canopy effects," numerous researchers have found a reduction in runoff and soil loss after utilizing mulches and crop residues (Table 1). Lal's (1976a) research on Nigerian Alfisols indicated that runoff and soil loss will exponentially decrease with an increasing mulch rate. Soil erosion was effectively controlled on 1-15% slopes with 2-4 tons of mulch per hectare.

Agronomic management practices, such as fertilization, plant population, type of selected crop, and cropping sequence, all contribute to the quality of protective vegetation cover and thus affect soil loss (Table 2). Hudson (1971) reported a 66% decrease in soil loss when maize was cropped for a high production level. He attained this level by increasing the nitrogen fertilizer rate from 20 to 100 kg/ha, and the plant population density from 25,000 to 35,000 plants/ha. As a result, the runoff decreased from 25 to 20 cm, and the soil loss from 12.3 to 0.7 t/ha.

Mannering and Johnson (1969) studied the effect of crop row widths on soil erosion. Maize planted in 51-cm rows reduced soil erosion by 24% in comparison to the 102-cm rows,

Table 1. Available Literature on the Effect of Cover on Runoff and Soil Loss

Soil	Type and Amount of Mulch	Runoff (% of Rainfall)	Soil Loss (t/ha)	Researcher/ Notes
Clay	Straw			Woodburn, 1944
	0 t/ha	44	47	
	4.5 t/ha	6	0.2	
Alfisol	Straw			Lal, 1976b
	0 t/ha	42	232.6	
	6 t/ha	2.4	0.2	
Alfisol	0 t/ha	69	-	Lawes, 1966 (mulch rates not provided by author)
	Grass	10	-	
	Peanut shells	11	-	
	Sorghum stalks	2	-	
Wea silt loam 5% cover	Surface cover			Mannering and Meyer, 1963
	0%	45	27.6	
	40%	40	7.2	
	60%	25	3.2	
	87%	5	0.7	
	98%	1.2	-	
Alfisol 5% slope	0 t/ha	67	-	Lal, 1976a first season
	2 t/ha	12	-	
	4 t/ha	2	-	
	6 t/ha	1.4	-	
	No till	1.8	-	
	0 t/ha	55	-	second season
	2 t/ha	26	-	
	4 t/ha	7.2	-	
	6 t/ha	1.6	-	
	No till	2.4	-	

Table 2. Available Literature on Crop Management and Its Effect on Runoff and Soil Loss

Crop Management	Soil Loss t/ha	Runoff	Researcher/Notes
Fallow	140	-	USDA, 1940
Gossypium sp.	50	-	
2-yr. rotation *Z. mays*--covercrop	25	-	
Z. mays/*Gossypium*/*Triticum aestivum*/ 2-yr. *Lespedeza cuneata*	20	-	
Grass	0.02	-	
Fallow	49.8	42 % of rainfall	Lal, 1976
Z. mays/*Z. mays* conventional plow	3.5	20 % of rainfall	(compiled from data
Cajanus cajan/*Z. mays* zero tillage	0.025	1.4% of rainfall	4-yr. cropping average
Z. mays/*Cajanus cajan* zero tillage	0.43	6.5% of rainfall	5% slope on alfisol)
Z. mays/*Z. mays* mulch	3.0	13 % of rainfall	
Manihot esculenta	87.4	49 % of rainfall	Aina, 1976
M. esculenta/*Z. mays*	43.6	33 % of rainfall	
Fallow	24.5	46.6 cm	Carrecker et al., 1977
Gossypium sp.	8.85	25.0 cm	(all planting up/down
Z. mays	4.9	17.9 cm	7% slope on Cecil series
3-yr. *Cynodon dactylon*-*C. dactylon*- *Z. mays*	0.88	7.3 cm	texture sandy loam sandy clay loam)
4-yr. *Festuca arundinacea*- *F. arundinacea*-*Z. mays*-*Z. mays**	1.34	18.6 cm	
Fallow (allowed natural weed to grow)	1.7	28.8 cm	Felipe-Morales et al., 1979
Potato + fallow up/down hill planting	4.7	49.2 cm	
Potato + fallow contour	1.9	26.4 cm	
Potato + *Lupinus* sp.	2.2	41.4 cm	
Wheat + fallow with mulch	1.7	24.2 cm	

*Cross slope planting

but the differences were not noticeable until the eighth week. The narrow row spacing (18 and 51 cm) of soybean (Glycine max (L.) Merr.) provided significantly more ground cover from three to four weeks earlier than the 102-cm rows. The narrow row soybean also increased infiltration by 24%, and decreased soil erosion by 35%.

Numerous researchers have tried to quantify the relationships between vegetative cover, runoff, and soil loss. Hudson (1971) stated that soil loss seems to be proportional to the amount of exposed ground surface. Wilkinson (1975) tried to quantify the soil loss and percent maize canopy cover in Nigeria, but did not find a good relationship as the canopy cover increased. Elwell and Stocking (1976) used ten years of data to obtain an exponential estimate of vegetative cover and soil loss in Rhodesia. Lal (1976a) quantified an exponential relationship for mulch rates, runoff, and soil loss. The runoff and soil loss decreased in an exponential rate with increasing mulch rates. Aina et al. (1979) produced regression equations for percent vegetative cover and soil losses for the following cropping systems in Nigeria: soybean (Glycine max L.), pigeon pea (Cajanus cajan (L.) Millsp.), maize, and cassava (Manihot esculenta Crantz.). Pigeon pea had the best correlation between canopy cover (x) and soil loss (y); the equation was:

$$y = 3.27e^{-0.01x}.$$

Singer and Blackard (1977) studied the relationship of mulch cover and soil loss on temperate soils under simulated rainfall. A parabolic relationship described this data better than an exponential one.

Wischmeier and Smith (1978) used a crop cover and management factor in the Universal Soil Loss Equation. The C factor, as they formulated it, combines all of the interrelated parameters which affect soil loss, including: time of planting, crop residue management, the type of crop, canopy cover, mulch on the ground, method of tillage, width of rows, plant population, and fertility.

Nitrates in the Surface Runoff

Aside from representing a direct loss to soil fertility, nitrates in the surface runoff may lead to the eutrophication of streams and lakes. This has led many investigators to examine the concentration and the total nitrogen in the runoff and sediment.

Nitrate and ammonium in the runoff can be easily determined, but the difficulty lies in pinpointing the source. Bryant and Slater (1948) presented the problem: the solute can originate from the soil, vegetation, and precipitation. Burwell et al. (1975) found the annual quantity of ammonium and nitrate contributed by precipitation to be greater than the N concentration in the surface runoff. Nicholaichuk and Read (1978) measured nitrates from some unfertilized Canadian watersheds and found the amount to exceed Sasketchewan's water quality criteria.

Many studies were made on N in the surface runoff in temperate soils. Moe et al. (1967) and White (1967) ran similar experiments on different soils. They broadcast N at a rate of 224 kg/ha on sod and fallow plots, and applied simulated rainfall at a rate of 12.7 cm/hr. The experiment on a fragipan soil lost 45 and 336 kg/ha of N from the sod and fallow plots; the sand loam soil lost 0.34 and 5.2 kg/ha of N from the sod and fallow plots.

The various tillage treatments can affect the N concentration in the surface runoff. Romkens et al. (1973) found concentrations ranging from 1.45 to 72 ppm and total N from 0.59 to 22.3 kg/ha due to various tillage treatments. Tillage methods that left the fertilizers on the surface had a higher N content in the runoff.

Barnett et al. (1972) reported on the results of Puerto Rican soils using a rainfall simulator, and applying 134 kg/ha of N. The runoff from conventionally tilled tobacco (Nicotiana sp L.) contained 0.41, 9.96, and 0.35 kg/ha of N on Humatas clay (Typic Tropohumult), Juncos silty clay (Vertic Ertropept) and Pandura silty loam (Typic Dystropept), respectively. Lal (1976b) found significant differences in the amount of nitrate in the runoff due to crop management (Table 3). In Hawaii, El-Swaify et al. (1976) found the annual precipitation contained about

Table 3. Crop Management and Its Effect on N in Runoff on 5% Slope, 120 kg N/ha as Urea (Lal, 1976b)

Treatment	kg/ha N in Runoff
Fallow	8.9
Maize	2.7
Cowpea Maize (plowed)	1.9
Maize (mulched)	0.7
Maize--Cowpea (no till)	0.4

1.5 ppm nitrate, and the surface runoff also contained a similar concentration.

Effect of Legumes on Maize Grain and Stover Yield

Intercropping usually results in competition for the plant's limiting factors, such as: water, oxygen, nutrients, light, and CO_2. Competition for water, nutrients, and light are probably the most limiting factors for intercrops of maize and low-growing legumes.

Kurtz et al. (1946) intercropped maize with white sweetclover (*Melilotus alba* Desr.) and red clover (*Trifolium pratense* L.). The objective of the experiment was to determine if an adequate supply of nitrogen and water would eliminate competition. The red clover plots treated with no nitrogen and water produced yields 45% and 55% below the control (no intercrop) plot for grain and stover. The addition of 56 kg N/ha only resulted in a yield decrease of 18% and 38% for grain and stover. The treatments with 56 kg N/ha and irrigation showed a yield decrease of only 4% and 2% for grain and stover. The white sweetclover plots showed similar trends. Later, Kurtz et al. (1952) intercropped maize with alfalfa (*Medicago sativa* L.), white sweetclover (*M. alba*), button clover (*Medicago orbicularis* All.), white clover (*Trifolium repens* L.), ladino clover (*T. repens var. ladino* L.), hop clover (*T. agrarium* L.), lespedeza (*Lespedeza sp.*), partridge pea (*Chamaecrista* _fasciculata_ Greene), and birdsfoot trefoil (_Lotus corniculatus_ L.). The legume treatments did not show any significant differences in grain yields; however, the intercropped grain yields were 10-15% lower than the conventional system.

In other field experiments, Nordquist and Wicks (1974) intercropped maize with alfalfa and found a 29% and 33% reduction in grain and stover, respectively, when compared to the control (no intercrop) treatment. Pendleton et al. (1957) intercropped maize with alfalfa, but kept a clean cultivated 25-cm band on each side of the maize row. The average three-year grain yield showed a 7% decrease due to intercropping.

Under tropical conditions, Dalal (1974) intercropped maize with pigeon pea (_Cajanus cajan_ (L.) Millsp.) and found a 35% reduction in maize grain yield in comparison to the control (no intercrop) treatment. In Nigeria, Agboola and Fayami (1971) intercropped maize with the following legumes: _Phaseolus lunatus_ L., _Mucuna utilis_, _Calopogonium mucunoides_ Desv., _Vigna sinensis_ (L.) Savi ex Hassk., and _P. aureus_ Roxb. _C. mucunoides_ and _V. sinensis_ caused no significant reduction in maize grain yield, while the other legumes reduced maize grain yields between 16-52%.

MATERIALS AND METHODS

The effects of legume ground cover and nitrogen rates on maize yields, soil loss, runoff, and nitrate in the runoff were studied in field experiments conducted during 1978 and 1979 at the Plant Materials Center (United States Department of Agriculture, Soil Conservation Service), Hoolehua, Molokai. The first crop was planted November 1978, and the second crop in July 1979. The average annual rainfall for the site is between 380-500 mm. Generally, 70% of the annual rainfall occurs during the period from November through March. The elevation is about 150 m with a mean annual temperature of 23.3^{o} C.

Soil Characteristics at the Experimental Site

The soil series at the site is Holomua silt loam. The current soil classification is clayey, kaolinitic, isohyperthermic, ustollic Camborthid. Some of the major characteristics measured are shown in Table 4, together with corresponding values of a published report (USDA, Soil Conservation Service, 1976).

Soil Analysis

Initially, nine soil samples were taken from the 0.13 hectare field. All samples were collected to a depth of

Table 4. Comparison of Published Soil Analysis (Soil Survey Investigation Report No. 29, Soil Survey Laboratory Data and Descriptions for Some Soils of Hawaii) and Analysis Obtained in This Study for the Soil at the Plant Materials Center, Hoolehua, Molokai

	Organic Carbon %	Total N %	Meq/100 g				pH 1:1 Paste	
			Ca^{++}	Mg^{++}	K^{+}	CEC		
0-30 cm	0.9	0.13	4.4	1.2	1.1	14.1	6.8	from SSIR no. 29
0-30 cm	1.1	0.09	5.6	2.4	1.3	14.9	6.6	soil test

15 cm and air dried for 24 hours. A 1:1 soil and water paste was mixed for pH measurements. Organic carbon determinations were made using the Walkley-Black method (Black, 1965). Available phosphorus was initially determined by the P-isotherm method (Fox and Kamprath, 1970); the modified Troug method (Ayres and Hagihara, 1952) was used to analyze the phosphorus for the second planting due to time constraints. The cation exchange capacity was determined with ammonium acetate adjusted to the soil's pH (Chapman, 1956). The Perking-Elmer Model 303 Atomic Absorption Spectrophotometer was used to determine potassium, calcium, and magnesium in the soil extract. The standards were prepared according to the directions in the Perkin-Elmer manual.

Experimental Design

The experimental design used was split plot with four replicates. The mainplot treatment for the first crop was nitrogen at rates of 190, 380, and 570 kg N/ha. The second crop's mainplot treatment rates were: 95, 195 and 285 kg N/ha.

The subplot treatments (vegetative cover) were: fallow (no cover), maize, maize + 'kalo' (*Lotus corniculatus var. arvensis*), and maize + rose clover (*Trifolium hirtum*). Hereafter, the subplot treatments are referred to as: fallow, maize, 'kalo', and rose clover.

The plot layout is shown in Figure 1. Each

Figure 1. Layout of plots in a splitplot experimental design. The mainplots had the following nitrogen rates:

N 1 = 190 (95)* kg N/ha

N 2 = 380 (190) kg N/ha

N 3 = 570 (285) kg N/ha

The subplots were:

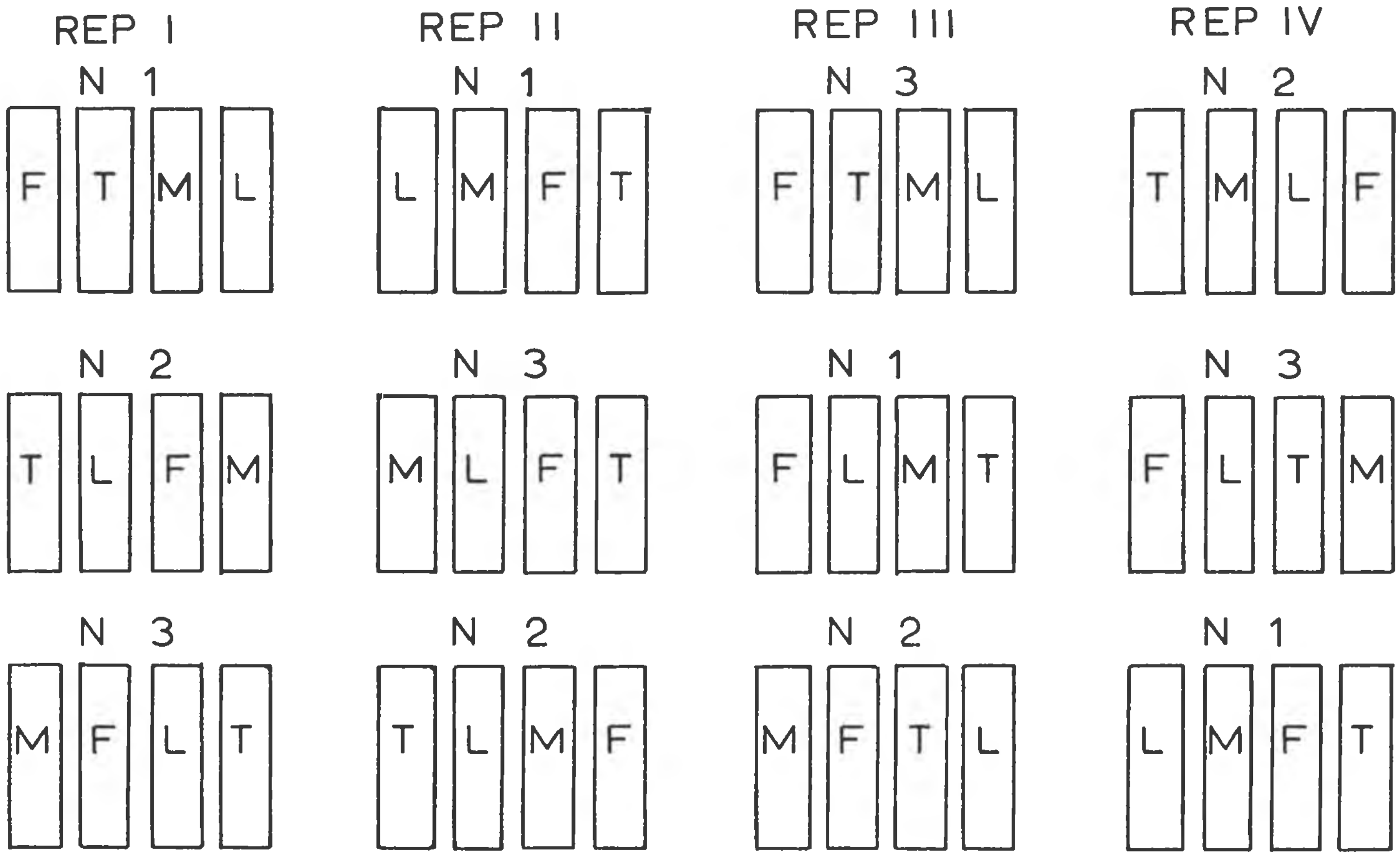
F = fallow

M = maize

L = 'kalo'

T = rose clover

*Number in paranthesis is the nitrogen rate for the second planting.


REP I
N 1
F T M L
N 2
T L F M
N 3
M F L T
REP II
N 1
L M F T
N 3
M L F T
N 2
T L M F
REP III
N 3
F T M L
N 1
F L M T
N 2
M F T L
REP IV
N 2
T M L F
N 3
F L T M
N 1
L M F T

subplot's dimensions were 1.5 x 6.0 m with an area of approximately 9 m^2. The subplot area, slope, LS factor, and subplot number are given in Appendix B, Table 23. A drip irrigation system (with 'T-Tape' laterals) was designed so the flow rate had a maximum $\pm$10% variation. A double row border of maize was used along each subplot. Figure 2 illustrates the border row, subplot dimensions, irrigation system for one replicate, and the 114-liter sediment collection containers installed at the lower end of each subplot.

The data were analyzed using the SAS analysis of variance program (Helwig, 1978) at the University of Hawaii Computer Center. Duncan's Multiple Range Test was used for mean separation.

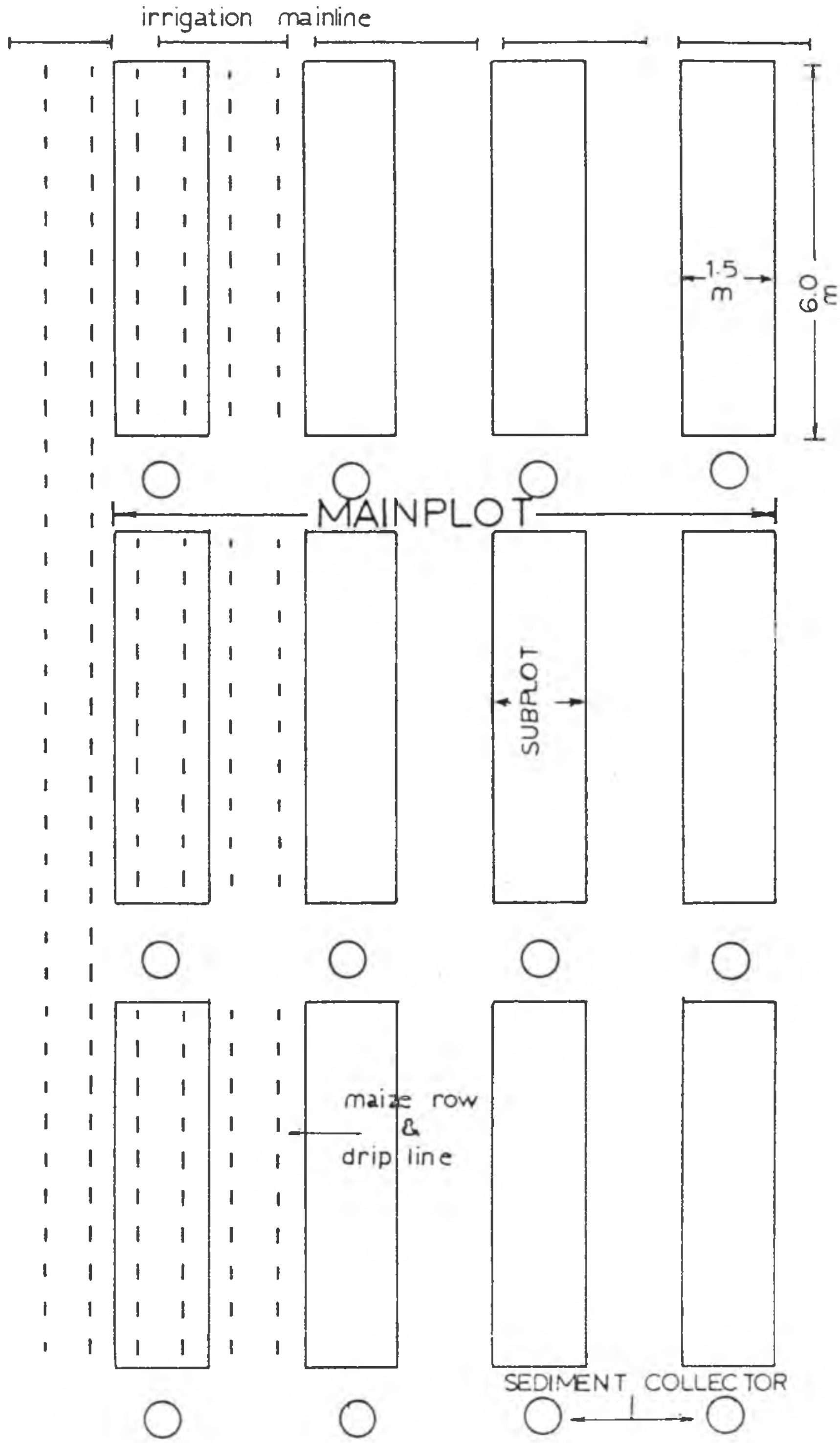
Plant Materials

Maize variety 'H-763' developed by Dr. J. L. Brewbaker (Department of Horticulture, University of Hawaii) was selected for its resistance to insect and disease.

The legumes, 'kalo' and rose clover, were selected based on evaluations provided in a USDA Soil Conservation Service report (Joy, 1977). The legumes were chosen for: rapid seedling emergence, a low growth habit, and the ability to spread fast. *Medicago hispida* Gaertn. also had met the selection criteria, but a seed source was not readily available.

Figure 2. Layout of One Repitition Showing Maize Rows, Drip Irrigation Lines, Sediment Collectors, and Dimension of Subplots

Scale: 2.54 cm = 3 m


irrigation mainline
1.5 m
6.0 m
MAINPLOT
SUBPLOT
maize row & drip line
SEDIMENT COLLECTOR

Fertilization

Nitrogen as urea was applied at rates of 190, 380, and 570 kg N/ha to the first crop planted on November 21, 1978. The nitrogen rates were high because of an error in the fertilizer application. The fertilizer intended for the mainplots was applied to the subplots. The nitrogen rates were decreased to 95, 190, and 285 kg N/ha for the second crop planted on July 11, 1979. The nitrogen applications were split: the first application was broadcast prior to planting, and incorporated into the soil with lawn rakes; the second application was a sidedressing three weeks after emergence of the maize. Phosphorus was broadcast as treble superphosphate and incorporated into the soil at a rate of 300 kg P/ha; however, no additional P was added for the second crop. Prior to planting the second crop, 1900 kg/ha of dolomite and 300 kg K/ha as muriate of potash were added.

The ear leaf was collected at maize silking and analyzed by Mr. Ernest Okazaki of the Department of Agronomy and Soil Science, University of Hawaii. The tissue samples were analyzed with the X-ray fluorescence Quantameter. The results are in Appendix A, Tables 19 and 20. The first crop's leaf analysis (Appendix A, Table 19) indicated borderline deficiency levels of calcium and potassium (Jones and Eck, 1973; Appendix A, Table 22).

Planting

Three maize seeds were planted per hill, and then thinned to one plant two weeks after emergence. The spacing was 76 cm between rows, and 23 cm between plants to constitute a population of 57,200 plants per hectare. The maize was planted in straight rows, up and down hill. Each subplot, except for the fallow treatment, contained two maize rows.

The rose clover and 'kalo' were broadcast at rates of 16.1 and 4.5 kg PLS/ha during the maize planting. The legume seeds were innoculated with rhizobium prior to planting.

Management Practices

Soil moisture level was maintained between 10-25 centibars throughout the study by the use of tensiometers. Each replication was drip irrigated through separate systems to maintain a maximum of $\pm 10\%$ variation in the emitter flow rate. The irrigation system had an average flow rate of 3.7 l/hr per 100 m at 0.35 kg/cm^2 of pressure. The plots were hand weeded to control the main weed, *Vigna luteola* (Jacq.) Benth. 'Malathion' and 'Sevin' were applied as needed to control insects.

Rainfall Monitoring

A continuously recording rainfall gauge was used to monitor the individual storm intensities, and for calculation of the rainfall erosivity factor (EI_{30}). The rainfall and erosivity factor for individual storms are displayed in Appendices C and E.

Maize Grain Yield Data Collection

Irrigation was terminated soon after the detection of physiological maturity of the maize grain (appearance of the black layer in the grain). Time from maize emergence to physiological maturity was approximately 94 and 120 days for the first planting (November 1978) and second planting (July 1979). The grain was harvested after the moisture level, determined with an electrical grain moisture meter, dropped to below 20%. Each subplot, having a maximum of 32 plants, was checked for the amount of ears prior to harvest. The total ear weight (husked) was recorded in the field, after which ten representative ears were picked and placed in plastic bags for further laboratory measurement. Ear weight, shelled grain weight, and grain moisture determinations were made to calculate the shelled maize grain yield at the standard 15.5% moisture.

Maize Stover Data Collection

The plants were cut at grain harvest time, 2.5 cm above the ground level, and weighed in the field. Immediately, ten subsamples were run through a shredder, and placed in plastic bags. Paper sacks with 500-gram samples were placed in a forced draft oven at 65^{o} C for 72 hours. Stover percent moisture was calculated so the stover yields could be expressed on an oven-dry basis.

Quantification of the Maize Canopy Cover

Photographs of the maize canopy were taken every two weeks with a 35-mm camera mounted on a 2.4 m pipe. Kodak Ektachrome Infrared film was used in combination with a number 12 filter, but was later discontinued when Kodak Ektachrome ASA 200 slides were found to be of equivalent quality. A fixed area of 1.7 m^2 of the subplots was photographed, thus sampling about 19% of each subplot. The canopy cover slide and a slide containing 280 systematically located dots were simultaneously placed in a Kodak Ektragraphic Audio Viewer. Percent cover was calculated by counting the dots overlapping the maize canopy and legume ground cover, then dividing the sum by 2.80.

Estimating Cover of Legumes Below the Maize Canopy

A method for estimating the legume cover was necessary because the total cover could not be accurately determined with photographs. For this purpose, a point frequency frame (Mueller-Dombois, 1974) was used to estimate percent legume cover. The frame consisted of ten parallel pins evenly spaced on a wooden frame. The percent cover was determined by placing the frame 20 times systematically along the subplots. The number of times a single pin contacted a legume was recorded for each placement. Percent legume cover was calculated by dividing the number of legumes contacted by a pin by 2.00.

Runoff Collection

Each subplot was bordered with 26-gauge galvanized sheet metal cut into 15 cm strips. The metal was inserted to a depth of 7.5 cm. Steel reinforcing bars were placed along the borders to provide mechanical support for the sheet metal. A collection trough, placed at the end of each subplot, collected the runoff and eroded soil. The sediment and runoff from the collection trough passed through a PVC pipe, and into a 114-liter sediment and runoff collection container. Following each storm, the total runoff was measured in liters, then converted to depth of flow (mm) and percent of rainfall to compensate for the variation in subplot area. A break in the precipitation for two hours or more was the criteria used to define the end of a storm.

Sediment Collection

Two 500-ml subsamples were taken from the sediment and runoff collection containers to determine the sediment concentration in the runoff water. The 500-ml subsamples were collected to represent sediment concentration throughout the depth of the collection containers by first vigorously mixing the runoff water, then sampling throughout the container's depth. In the laboratory, the subsamples were treated with 2 ml of 1 N HCl to induce flocculation, and then left undisturbed for 24 hours. The supernatent was then decanted, except for 50 ml used to determine the nitrate concentration of the runoff. The sediment was placed in an oven for 36 hours at 110^{o} C, then allowed to cool prior to weighing on the top loading 'Mettler' balance. The sediment weight was then converted to soil loss per hectare per storm. The 'LS' factor from the Universal Soil Loss Equation (Wischmeier and Smith, 1978) was used to convert the soil loss to equivalent soil loss from a 'standard' USLE plot, 9% slope and 22.1 m. This conversion allowed comparison between soil losses that originated from plots with different percent slopes.

Nitrates in the Runoff

The 50-ml samples for nitrate were refrigerated at 5^{o} C in plastic vials. Nitrate determinations were made with a specific ion electrode at the University of Hawaii. The concentration of nitrates was converted to kg nitrate per hectare.

Soil Loss Ratio for the Management System

A fallow subplot was included in each mainplot, as a control to calculate a relative soil loss ratio similar to the C factor of the USLE. This factor shows the relative decrease in soil loss because of the vegetative cover.

RESULTS AND DISCUSSION

Effect of Nitrogen Rates on the Maize Canopy and Legume Ground Cover

The developments of the maize canopy and legume ground cover will be discussed before the other results because of their integral interaction with runoff, soil loss, and grain yields. The data is shown on Tables 5 and 6.

Maize canopy cover. The maize canopy achieved its maximum canopy cover between 63 and 84 days after emergence (Tables 5 and 6). The trend was apparent in the first planting (November 1978) and second planting (July 1979). The maximum differences produced by the nitrogen treatments on canopy cover were 7% at 84 days from emergence for the first planting, and 20%, 42 days after emergence for the second planting. In both plantings, the canopy cover declined at the end of the crop cycle. This was probably due to the increasing nitrogen rates that showed a trend of increasing the maize canopy cover. The maize canopy cover was not appreciably affected by the presence of the legume ground cover.

Legume ground cover. 'Kalo' and rose clover showed a general trend of reduction in legume cover with increasing

Table 5. Percent Cover of the Maize Canopy, and Legumes as Affected by Nitrogen Rates and Days After Maize Emergence for the First Crop (November 1978)

Vegetative Treatment	N Rates kg/ha	28 M	28 L	49 M	49 L	63 M	63 L	84 M	84 L	126 M	126 L
		Days After Maize Emergence									
Maize	190	23		86		90		88		55	
	380	23		91		93		90		57	
	570	23		93		96		94		62	
Maize + 'kalo'	190	24	5	86	22	89	31	89	36	60	49
	380	22	4	84	15	93	15	90	22	34	40
	570	23	3	89	20	94	14	92	25	58	32
Maize + rose clover	190	21	26	84	67	90	73	87	64	57	76
	380	23	27	90	59	89	62	89	52	58	63
	570	22	16	92	45	94	52	92	44	58	61

M = Maize canopy cover

L = Legume ground cover

Table 6. Percent Cover of the Maize Canopy, and Legumes as Affected by Nitrogen Rates and Days After Maize Emergence for the Second Crop (July 1979)

Vegetative Treatment	N Rates kg/ha	Days After Maize Emergence 11 M	11 L	31 M	31 L	42 M	42 L	49 M	49 L	60 M	60 L	80 M	80 L	98 M	98 L
Maize	95	10		27		68		86		88		88		79	
	190	9		29		82		90		93		92		84	
	285	9		30		88		93		93		96		85	
Maize + 'kalo'	95	9.8	3	30	5	72	13	88	22	90	27	90	42	82	34
	190	9.5	3	28	4	78	9	35	22	92	31	89	27	84	22
	285	10.5	3	30	5	78	11	92	14	92	16	93	20	92	19
Maize + rose clover	95	9.0	5	26	12	70	27	87	44	87	49	88	42	82	35
	190	8.9	5	28	14	76	32	92	43	92	39	91	36	86	32
	285	10.9	6	26	15	78	29	91	49	93	39	91	40	86	22

nitrogen rates. The decrease in cover with higher nitrogen rates may be due to shading by the maize canopy. Shading decreases the rate of carbohydrate accumulation. These factors, in combination with the low amounts of winter sunlight, could have affected the legume growth.

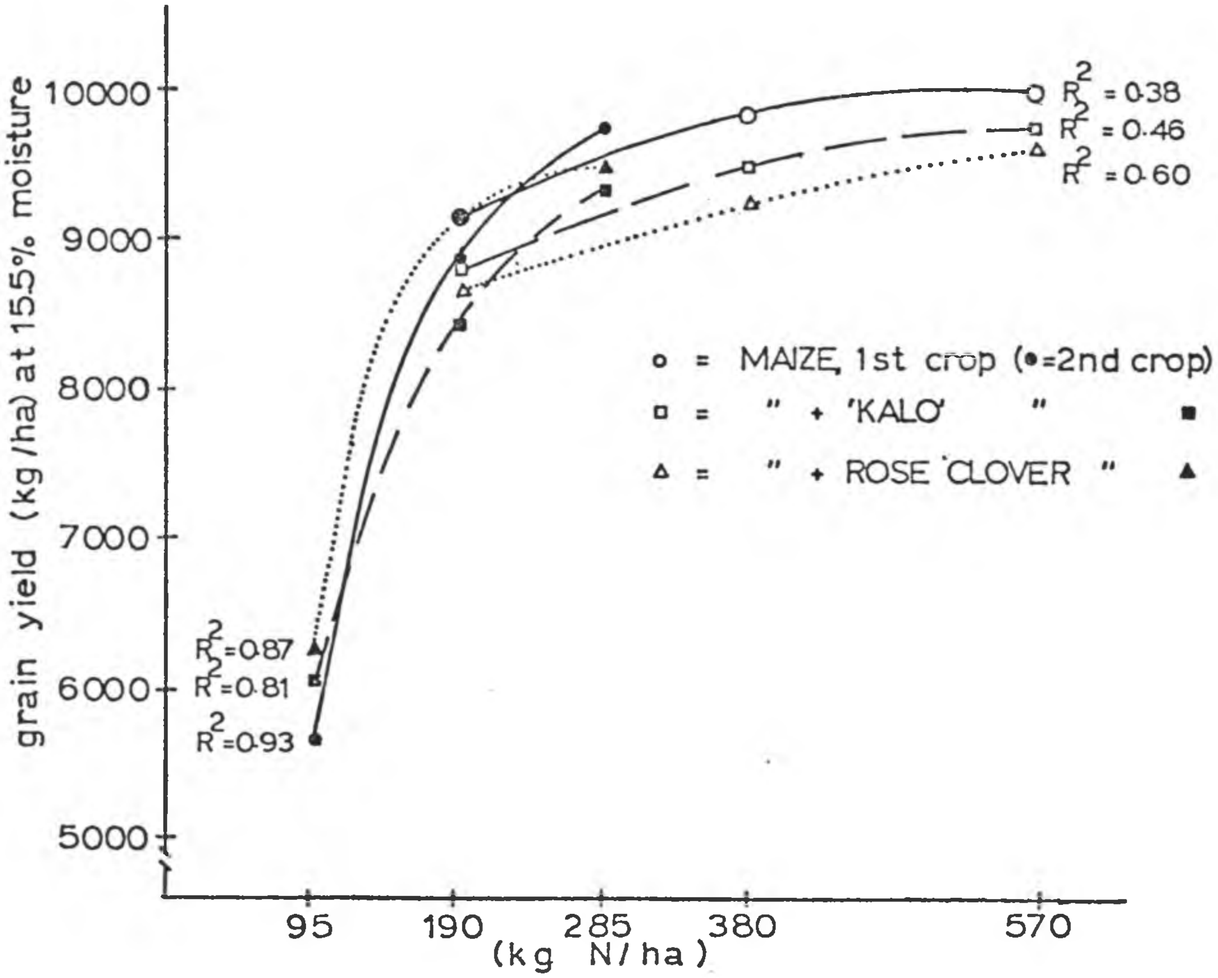
The trends observed were similar for both legumes, 'kalo' and rose clover, but the difference was in the total amount of ground cover. The rose clover had an average of 25% greater ground cover than 'kalo' in the first planting at 80 days after emergence, and 9% in the second planting. The difference in ground cover between the first and second planting of rose clover was caused by a fungal disease.

Effect of Nitrogen Rates and Intercropped Legumes on Grain Yields

The first and second maize crops were planted on November 21, 1978 and on July 9, 1979, respectively. The time from planting to physiological maturity (black layer formation) was 120 days for the first and 94 days for the second. The dry down period, from physiological maturity to a grain moisture level of 20% or less, required about five weeks.

Effect of nitrogen rates on grain yields. The effect of nitrogen on the grain yield of the first and second crops are shown separately for each legume treatment (Figure 3), and in a composite curve for all treatments

Figure 3. Effect of N and Legumes on Maize Grain Yields



(Figure 4). Statistical analysis (Tables 7 and 8) revealed a significant yield response to nitrogen at the 95% probability level in the first and second crop. However, certain distinctions need to be put forth for each of the crops:

1. The first planting (November 1978). The nitrogen (mainplot) mean on Table 9 did not show any significant increase in grain yields above the fertilizer rate of 380 kg N/ha. The maize + rose clover was the only treatment that did not show any significant yield increase between 190-380 kg N/ha. The maize + rose clover treatment had the highest percent of legume cover (Table 5), a factor that may have produced the nonsignificant yield increase. The CV for maize + 'kalo' was higher than maize + rose clover, so there is a probability that the effect was due to competition from the rose clover. Since the N uptake in the grain was similar (Table 10) for the two legume treatments, this may indicate that competition for water was a limiting factor to grain yields in the rose clover treatment. The uptake of P and K by the legume treatments were similar to the maize alone (Appendix A, Table 20a). Although the average increase in grain yield was only 7%, there appears to be a definite trend of increasing grain yields up to 570 kg N/ha.

2. The second planting (July 1979). The trend (Table 9) is similar to the first crop's yield, i.e., increasing fertilizer rates with a corresponding increase in

Figure 4. Effect of N on Grain Yields

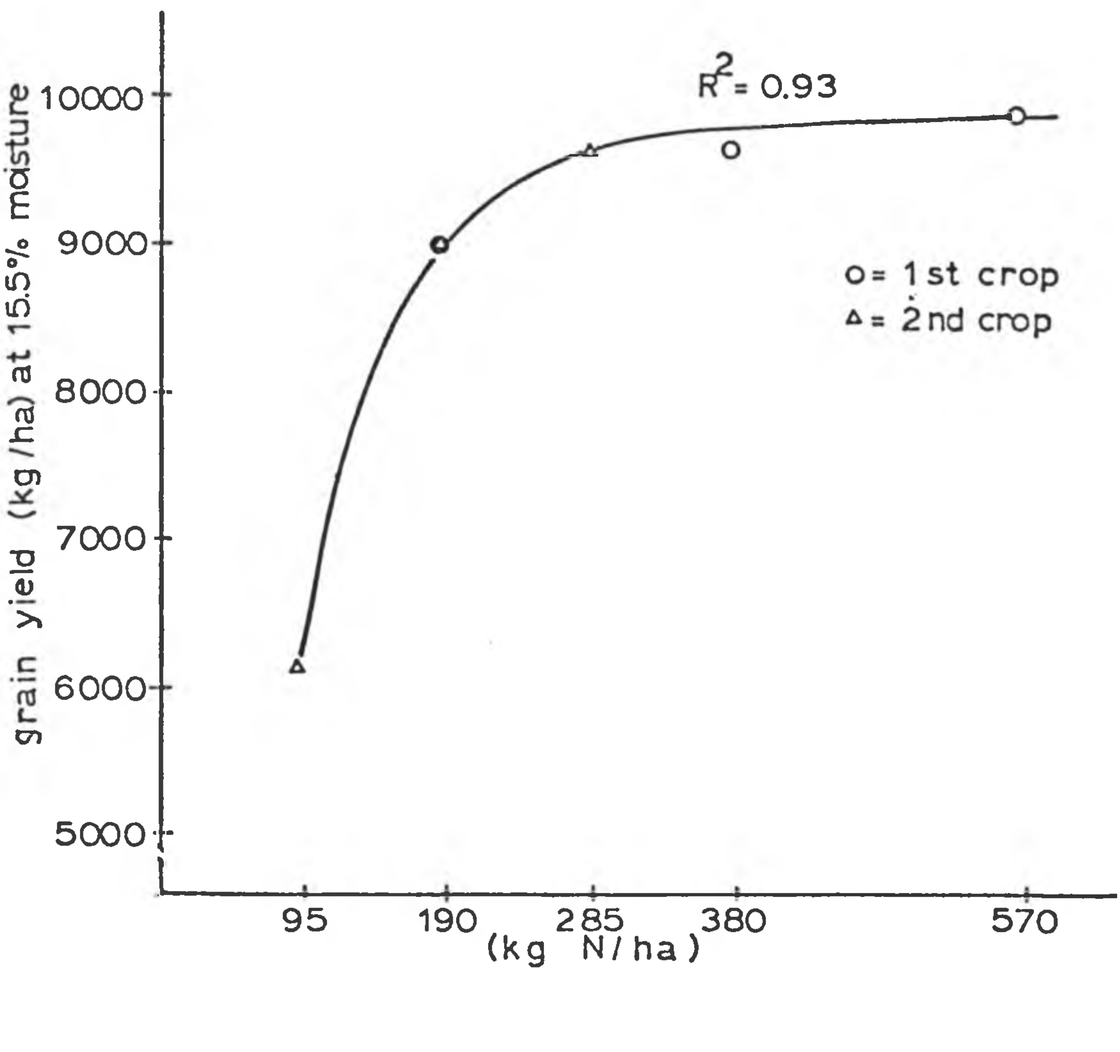


Table 7. Analysis of Variance for Maize Grain Yield (First Planting, November 1978)

Source	df		MS	
Subplots	35		398450.0	
Mainplot	11			
Block		3	304548.7	
Nitrogen		2	2875196.0	*
MP Error		6	412983.0	
Cover	2		717504.5	*
Cover x Nitrogen	4		19566.5	
Subplot Error	18		182807.7	

CV = 4.5

* = significant at p=0.05

Table 8. Analysis of Variance for Maize Grain Yield (Second Planting, July 1979)

Source	df		MS	
Subplots	35		28558278.	
Mainplot	11			
Block		3	805869.3	
Nitrogen		2	42105991.0	*
MP Error		6	637024.7	
Cover	2		310711.5	
Cover x Nitrogen	4		391164.8	
Subplot Error	18		405341.8	

CV = 7.8

* = significant at p=0.05

Table 9. Effect of Nitrogen Rates (and Various Legume Treatments) on Maize Grain Yields (kg/ha)

N Rate (kg/ha)	Maize (kg/ha)	Maize + 'Kalo' (kg/ha)	Maize + Rose Clover (kg/ha)	Mean of N Rates (kg/ha)
1st crop				
190	9186 ax	8841 ax	8723 ax	8917 a
380	9924 bx	9563 bx	9304 ax	9597 b
570	10075 bx	9802 bx	9723 ax	9867 b
Mean of maize + legume treatments	9728 x	9402 xy	9250 y	
2nd crop				
95	5714 ax	6138 ax	6295 ax	6049 a
190	8987 bx	8515 bx	9236 bx	8912 b
285	9822 bx	9404 bx	9492 bx	9573 b
Mean of maize + legume treatments	8174 x	8019 x	8341 x	

Means with the same letters are not significantly different (p=0.05). Letters a, b are for comparisons within columns; letters x, y are within rows.

Table 10. Amount of N Uptake (kg/ha) in the Seeds of the First Planting (November 1978)

N Rate kg/ha	Rep	Treatment: Maize (kg N/ha)	Maize + 'Kalo' (kg N/ha)	Maize + Rose Clover (kg N/ha)
190	1	123.4	105.9	98.9
	2	125.5	117.9	131.9
	3	119.1	141.4	123.1
	4	126.9	109.1	120.0
	Mean	123.7	118.6	118.5
380	1	169.0	133.8	143.2
	2	133.5	127.8	140.0
	3	182.8	149.7	156.8
	4	182.4	164.5	141.2
	Mean	166.9	143.9	145.3
570	1	186.0	161.4	157.8
	2	178.0	168.5	166.3
	3	184.3	161.5	187.8
	4	182.9	196.6	182.0
	Mean	182.8	172.0	173.4

grain yield. Residual N was present, as indicated by the uptake of more N by the legume treatment (Table 11) when compared to the control (maize alone). The increases in grain yield were 47 and 7% for the fertilizer intervals between 95-190 and 190-285 kg N/ha, respectively. A composite curve for both crops (Figure 4) indicated that the optimum nitrogen rate is between 190-200 kg N/ha, which agrees with other results from Hawaii (e.g., Azih, 1978). The correlation coefficient for a second order polynomial was 0.95 (n=18). The grain yields for the two plantings were surprisingly similar, considering that the summer months received almost twice the solar radiation. Lee (1978) showed that the same maize cultivar 'H-763' had almost two times the yield during summer as compared to winter planting. Appendix I contains the meteorological data for sunlight and temperature at Mauna Loa, Molokai, about 10 miles away from the Plant Materials Center, but on the same leeward coast-line. The leaf tissue analysis (Appendix A, Tables 19 to 21) showed no deficiencies, which may indicate the presence of nutrient stresses in the second crop. Six tensiometers were kept between 10-20 centibars throughout the experiment. However, they may not have been sufficient in number for representing all the different plots or water depletion pattern in the drip irrigated root zone. Thus, there may indeed have been a water deficit in the second crop, which in contrast to the first, received only 25.4 mm of rainfall. It

Table 11. Amount of N Uptake (kg/ha) in the Seeds of the Second Planting (July 1979)

		Treatment		
N Rate kg/ha	Rep	Maize (kg N/ha)	Maize + 'Kalo' (kg N/ha)	Maize + Rose Clover (kg N/ha)
95	1	72.5	74.9	75.5
	2	55.5	76.4	84.5
	3	54.6	66.6	70.8
	4	60.2	52.6	57.4
	Mean	60.7	67.6	72.0
190	1	136.4	128.4	132.8
	2	128.1	91.1	120.3
	3	98.6	121.2	153.7
	4	140.5	124.6	136.2
	Mean	125.9	116.3	135.8
285	1	164.3	152.5	161.2
	2	157.9	143.3	157.7
	3	138.2	168.4	150.9
	4	134.5	155.5	133.9
	Mean	148.7	154.9	150.9

is also worthy to note an observation by Lee (1978) who stated that maize variety 'H-763' had a negative correlation between grain yield and high temperatures; no data was provided on the tolerable temperature limits of the plant.

Effect of intercropped legumes on maize grain yields. The legume ground covers had a significant effect on grain yields only in the first crop (Tables 7 and 8). The effects of legumes on grain yields are illustrated in Figure 3.

1. The first planting (November 1978). The trends indicated a decrease in grain yields due to the intercropping of rose clover, which significantly decreased grain yields by 5%, when compared to maize alone. It seems the decrease in grain yields caused by the presence of rose clover may be due to the increased amount of vegetative material present. The rose clover probably competed with the maize for water and nutrients. Some of the early research suggested that an unlimited supply of water and nitrogen will minimize the competition between intercropped plants by sufficiently meeting the demands of both (Kurtz et al., 1946, 1952; Agboola and Fayemi, 1971). This hypothesis is supported by the observed decrease in competition with increasing nitrogen rates; at 190 kg N, addition of rose clover decreased grain yields by 5.2%, but only by 3.6% at 570 kg N/ha. Other researchers have found greater depressions of maize grain yields due to the addition of legumes: Medicago sativa

decreased grain yields by 30% (Nordquist and Wicks, 1974); Vigna sinensis caused a 12% reduction in grain yields (Agboola and Fayemi, 1974).

2. The second planting (July 1979). No significant differences in yields were observed for the second crop due to the legumes. The apparent relative ranking of maize grain yields under the various treatments was: maize + rose $>$ clover $>$ maize $>$ maize + 'kalo'. The added N due to incorporation of the top growth of legumes was nearly 229 kg N/ha for rose clover, and 89 kg N/ha for 'kalo'. The air dry weight of the legume top growth and the leaf nitrogen content for selected plots are shown in Appendix H. The additional amount of nitrogen added to the soil by rose clover may account for the higher yields in the maize + rose clover plots.

Interaction between nitrogen rates and intercropped legumes. Such interaction was not statistically significant for either the first or the second crops (Tables 7 and 8). However, certain trends could be observed for the two crops as follows:

1. The first planting (November 1978). The trend reveals a decrease in grain yields with an increase in percent of legume cover. Table 5 displays the legume cover for the first crop: 'kalo' had an average cover of 40% and rose clover an average of 67%, measured 126 days after the

emergence of maize. For a given nitrogen level, greater legume cover resulted in a slight decline in yield. Figure 5 indicates the intercropped legume treatments could attain the grain yields of maize with added fertilizers. The maize + 'kalo' treatment would need to be fertilized at a rate of 265 kg N/ha for equivalent maize grain yields at 190 kg N/ha. It appears that the maize + 'kalo' treatment needed an additional 75 kg N/ha. The same comparison of maize + rose clover and maize reveals that the fertilization at a rate of 325 kg N/ha (135 kg of additional N) would be necessary to attain equivalent grain yields.

2. The second planting (July 1979). There were no significant interaction and legume effects, but the trends seem to indicate that the residual N from the incorporated rose clover caused an increase in maize grain yield.

Summary. The point of diminishing returns for nitrogen fertilization was between 190-200 kg N/ha, which verifies current Hawaiian research. Legumes in the first crop are likely to be a strong competitor for water and other nutrients unless extreme care is used to assure sufficient amounts. The value of legumes will appear in the second crop; the competition for nutrients by the legumes seems to be diminished through the recycling of nutrients.

Figure 5. Estimating the Contribution (Competition for) of Nitrogen from Legumes

The maize grain yield of maize treatment is used as the basis for the 'standard' curve. The maize + legumes treatment may deviate from the 'standard' curve. If the treatments grain yield is known, the available nitrogen can be approximated.

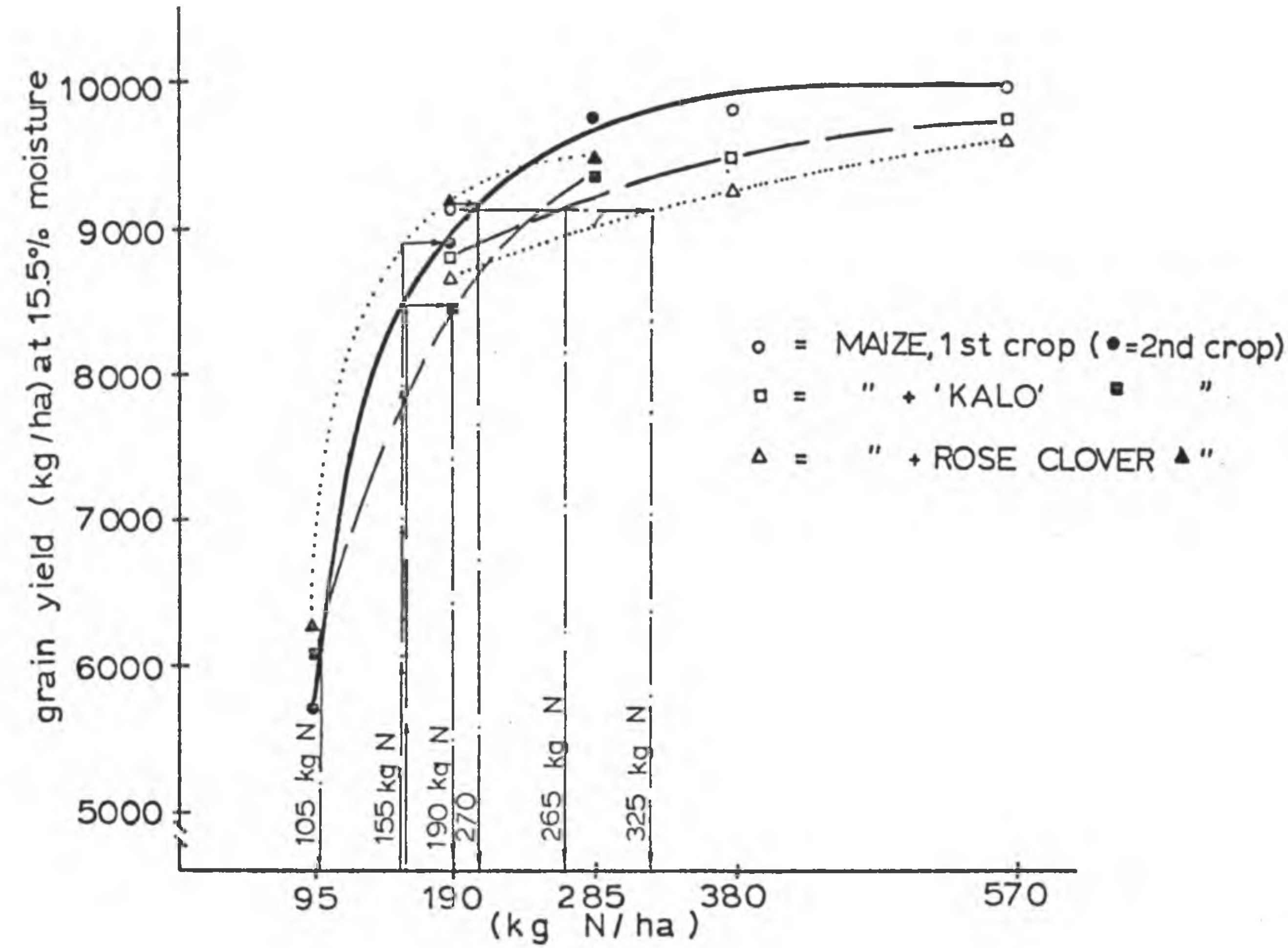

grain yield (kg/ha) at 15.5% moisture
10000
9000
8000
7000
6000
5000
105 kg N
155 kg N
190 kg N
270
265 kg N
325 kg N
95
190
285
380
570
(kg N/ha)
o = MAIZE, 1 st crop (•=2nd crop)
□ = " + 'KALO' ■ "
△ = " + ROSE CLOVER ▲ "

Table 12. Analysis of Variance for Maize Stover Yields (First Planting, November 1978)

Source	df		MS	
Subplots	35		944335	
Mainplots	11			
Block		3	1681850	
Nitrogen		2	2618425	*
MP Error		6	346012	
Cover	2		233470	N.S.
Cover x Nitrogen	4		260047	N.S.
Subplot Error	18		1065896	

CV = 15.8%

* = significant at p=0.05

Table 13. Analysis of Variance for Maize Stover Yields (Second Planting, July 1979)

Source	df	MS	
Subplots	35	1544882	
Mainplots	11		
Block	3	418845	
Nitrogen	2	15803352	*
MP Error	6	1903072	
Cover	2	444304	N.S.
Cover x Nitrogen	4	854180	N.S.
Subplot Error	18	304659	

CV = 7.8

* = significant at p=0.05

Table 14. Effect of Nitrogen Rates and Legumes on Maize Stover Yields

N Rate kg/ha	Maize kg/ha	Maize + 'Kalo' kg/ha	Maize + Rose Clover kg/ha	Mean of N Rates kg/ha
1st planting (November 1978)				
190	6066 x a	6084 x a	5981 x a	6044 x
380	6721 x a	6366 x a	6558 x a	6548 xy
570	7297 x a	7058 x a	6731 y a	7029 y
Mean of maize + legume treatments	6695 a	6603 a	6424 a	
2nd planting (July 1979)				
95	6025 x a	6228 x a	6012 x a	6088 x
190	7492 x a	6266 x a	6964 x a	6907 x
285	8485 y a	8653 y a	7925 y a	8354 y
Mean of maize + legume treatments	7334 a	7049 a	6967 a	

Means with the same letters are not significantly different (p=0.05). Letters a, b, c are for comparison within columns; letters x, y are within rows.

Effect of Nitrogen Rates and Intercropped Legumes on Stover Yields

The nitrogen treatment produced highly significant effects on stover yields (Tables 12 and 13). The treatment effect for legume and nitrogen means are shown on Table 14. Figure 6 shows the effect of nitrogen and legumes on stover yields.

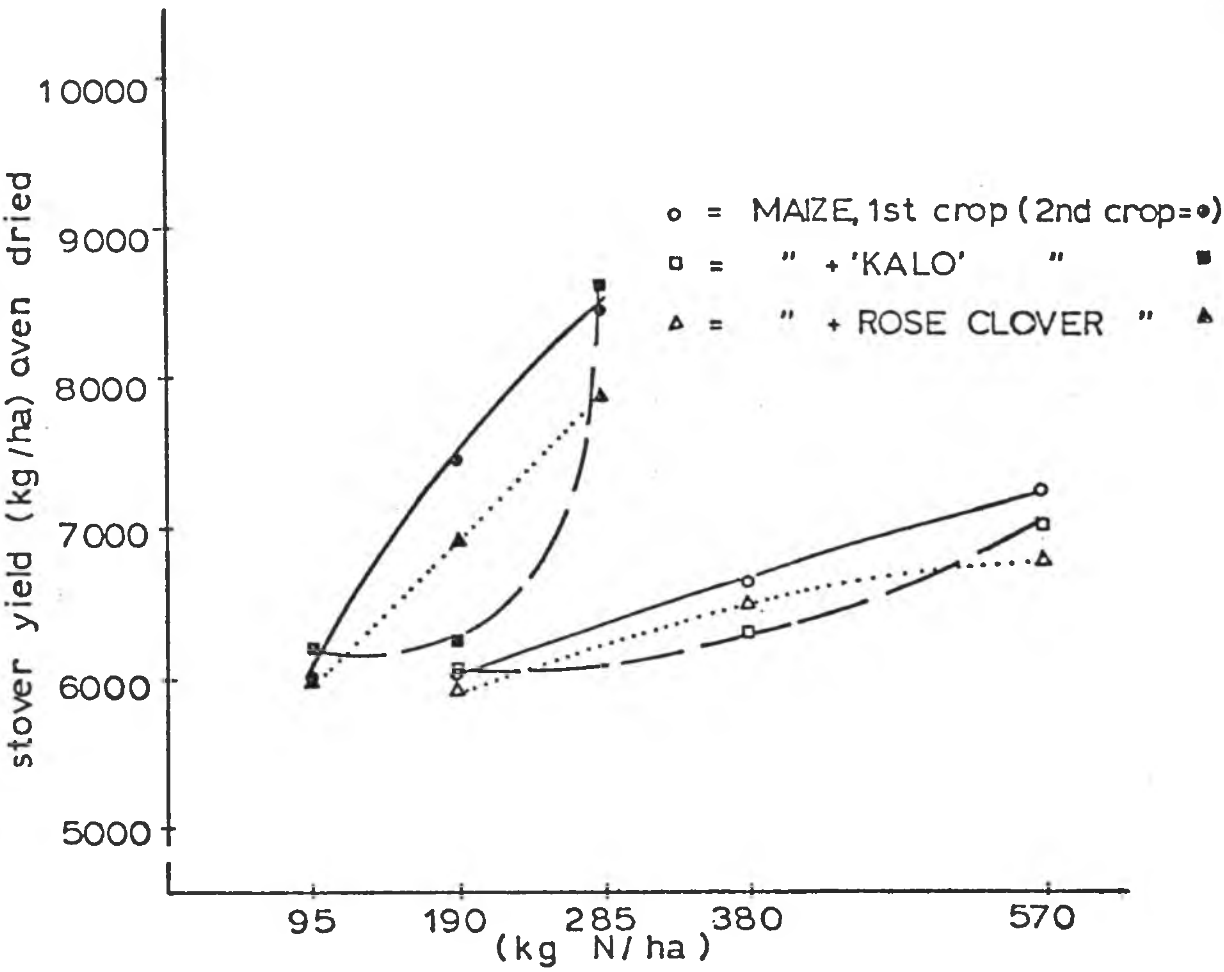
Effect of nitrogen rates on stover yields.

1. The first planting (November 1978). Increasing nitrogen rates resulted in the increase of stover production, although the only significant difference was between 300 and 570 kg N/ha rates. This experiment may be confounded by the high winds which prevailed during the dry down period. Many of the leaves were wind-stripped from the plants and lost.

2. The second planting (July 1979). The trend was of increasing stover production with sequential increases in fertilizer rates. The rate of 285 kg N/ha was significantly different from all other rates. Stover yields from this harvest were much higher than the first crop due to the time of planting and possibly the added nitrogen from the incorporated legumes.

Effect of legumes on stover yields--first (November 1978) and second (July 1979) plantings. Legume ground cover had no significant effect on stover yields. There appears to

Figure 6. Effect of Nitrogen and Legumes on Stover Yields



be a slight trend of decreasing yields with increasing legume cover, probably because of competition for water and nutrients. There appears to be no trend within a specific nitrogen rate. Nordquist and Wicks (1974) had a 33% reduction in silage when maize was fertilized at a rate of 134 kg N/ha and intercropped with 'Ranger' alfalfa.

Summary. The legumes did not affect stover yield, but nitrogen had a highly significant effect on yields. The results for stover are confounded because of the high winds which stripped away many leaves near harvest time.

Effect of Nitrogen Rates and Vegetative Cover on Runoff

The data of all storms (17) are in Appendix C. Only storms that coincided with the first crop will be discussed because there was only a single erosive storm during the second crop. All data shown represent the cumulative total for the first crop cycle (November 1978-February 1979). Individual storms did not show clear trends; this problem confirms the established understanding that variability of soil hydrological data requires long term studies to develop reliable quantitative trends. The total rainfall during this period was 463.3 mm. The statistical analysis (Table 15) shows that only the cover had significant effects.

Effect of nitrogen rates on runoff. The statistical analysis showed no significant differences in cumulative

Table 15. Analysis of Variance--Cumulative Runoff

Source	df		MS	
Subplots	47		128	
Mainplot	11			
Block		3	103.2	
Nitrogen		2	25	N.S.
MP Error		6	90	
Cover	3		147.5	*
Cover x Nitrogen	6		37.8	N.S.
Subplot Error	27		17.7	

CV = 6%

* = significant at p=0.05

runoff due to the nitrogen treatments. Table 16 shows no significant trends. The nonsignificance of nitrogen fertilization is probably due to the extremely high fertilizer rates unintentionally applied in all treatments. Hudson (1971) reported a decrease in runoff after increasing nitrogen from 20 to 100 kg N/ha, but the plant population was also increased by 48%. The general belief is that runoff would decrease with increasing nitrogen rates if the initial soil N levels are low, thus showing significant improvement in vegetative cover with increasing nitrogen rates.

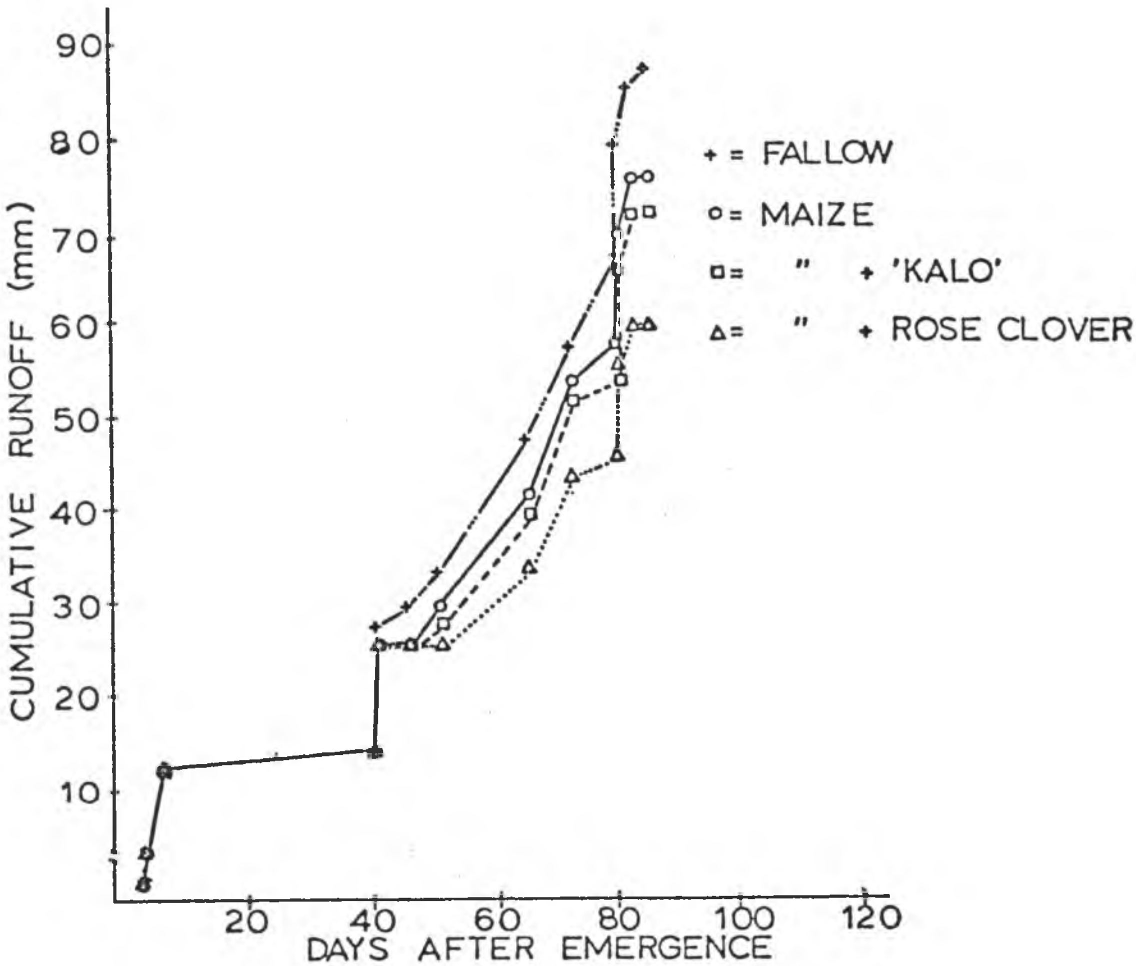
Effect of vegetative cover on runoff. The effects of vegetative cover on runoff were highly significant. The results for the combined N rates of the cumulative runoff are shown in Figure 7 and Table 16, and the data for individual storms and plots are presented in Appendix C, with cumulative runoff in Appendix D. The runoff losses were in the following order: fallow > maize > maize + 'kalo' > maize + rose clover. As expected, fallow plots produced the greatest runoff. Runoff from these plots was significantly different from all other treatments at the 95% probability level. All mean cover treatments were significantly different at a 90% probability level. The cover treatments were all significantly different from each other at the 190 kg N/ha rate at an 80% probability level. During the first 40 days, the vegetative treatments did not produce visible results (Figure 7); but after 40 days, and also coinciding with a

Table 16. Effect of Nitrogen Rates and Vegetative Cover on Cumulative Runoff

N Rates (kg/ha)	Cumulative Runoff (mm)			
Treatment	190	380	570	Mean
Fallow	90.60 hw	84.52 hw	87.62 hw	87.58 ah
Maize	76.78 ix	73.20 ix	77.72 ix	75.90 bi
Lotus	72.84 iy	70.14 ix	74.46 ix	72.48 bj
Trifolium	56.32 jz	63.77 jy	61.84 jy	60.64 ck
Mean--N	74.14	72.91	75.41	

Letters a--d: p=0.05
h--k: p=0.10
w--z: p=0.20

Figure 7. Effect of Vegetative Cover on Cumulative Runoff



Appendix F.

Summary. The effect of vegetative cover became pronounced after 40 days when the legume cover became better developed, thus providing more of a decrease in the overland flow velocity. This period also coincided with more significant storm events which allowed differences in vegetative cover to be better expressed.

Effect of Nitrogen Rates and Vegetative Cover on Soil Loss

The data presented in Figure 8 represent measured cumulative soil losses for the combined N treatments as a result of all storms received during the first planting. The soil loss data were standardized for a uniform topography of 9% slope gradient and 22.1 meter slope length to compensate for their different topography (explained in the Materials and Methods section). The standardized data are presented in Figure 8 and Table 18. Data for individual storms are presented in Appendices C and D.

Effect of nitrogen fertilization on soil loss. The nitrogen treatments had no significant effects on soil loss (Table 17) and no general trends are apparent (Table 18). These results, like those of runoff, may be explained by the fact that maize canopy cover was not discernibly different for various N treatments due to the high nitrogen application rates in all.

pronounced increase in maize and legume cover (Table 6), the effect of vegetation was noticeable. During the early growth stages, the legumes were well established only near the drip irrigation lateral lines, and never did provide a complete stand throughout the plots. If sufficiently irrigated, the legumes may have provided better cover and, therefore, less runoff. The lack of treatment effects in the early growth may have also been caused by the relatively small quantity of rainfall received then; only 20% of the total rainfall was received during the initial 33% of the crop's growth period. The vegetative treatments reduced runoff by the following amounts in comparison to fallow: maize, 13%; maize + 'kalo', 17%; maize + rose clover, 31%.

The collected runoff from the fallow plots represented 19% of the total rainfall. In comparison, studies by Lal (1976b) on Nigerian Alfisols with a 5% slope showed that the fallow plots had an average annual runoff of 63% of the total precipitation. Barnett et al. (1972) used about 19 cm of simulated rainfall and found that the fallow plots on Puerto Rican soils had 37, 92, and 32% runoff for the following soil types: Humatas clay, 39% slope; Juncos silty clay, 37% slope; and Pandura silt loam, 27% slope, respectively.

The runoff was also analyzed for nitrate concentration, but many of the samples were lost. The remaining samples were analyzed and the results are presented in

Figure 8. Cumulative Soil Loss Corrected for Slope to Equivalent Soil Loss on a 9% Slope, 22.1 m Length

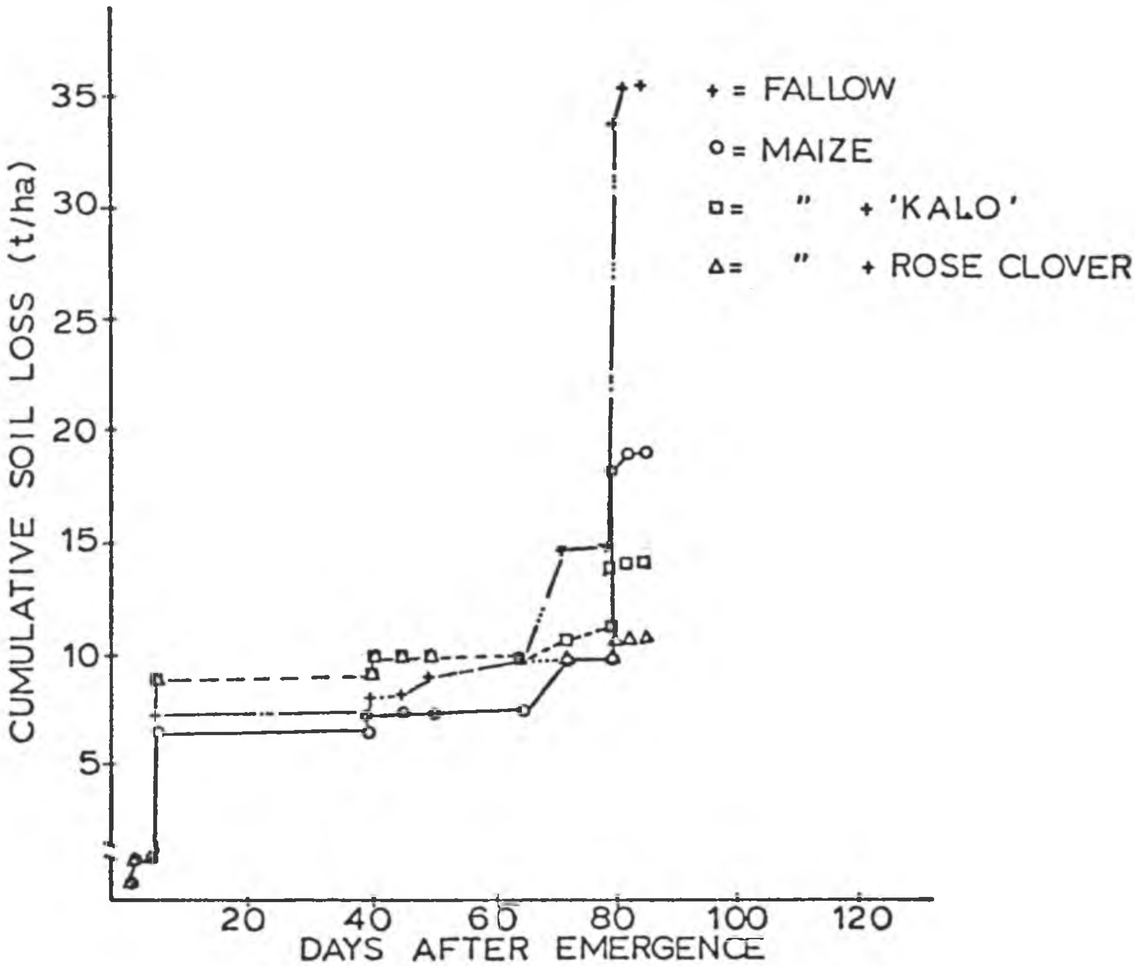


Table 17. Analysis of Variance--Cumulative Soil Loss

Source	df	MS	
Subplots	47	9892.541	
Mainplot	11		
Block	3	81.165	
Nitrogen	2	116.069	0.33 N.S.
MP Error	6	1062.708	
Cover	3	4273.606	10.77 ***
Cover x Nitrogen	6	788.366	0.99 N.S.
Subplot Error	27	3570.627	

CV = 59.5

*** = very highly significant at alpha = 0.01

Table 18. Effect of Nitrogen Rates and Vegetative Cover on Soil Loss

N Rates (kg/ha)	Cumulative Soil Loss (t/ha)			
Cover	190	380	570	Mean
Fallow	39.96 w	23.58 w	41.19 w	34.91 hw
Maize	17.32 x	17.92 x	19.52 x	18.25 ix
Lotus	16.12 x	15.02 x	10.33 x	13.82 ixy
Trifolium	7.57 x	12.00 x	11.29 x	10.28 iy
Mean--N	20.24	17.13	20.58	

Letters h--k: p-0.10

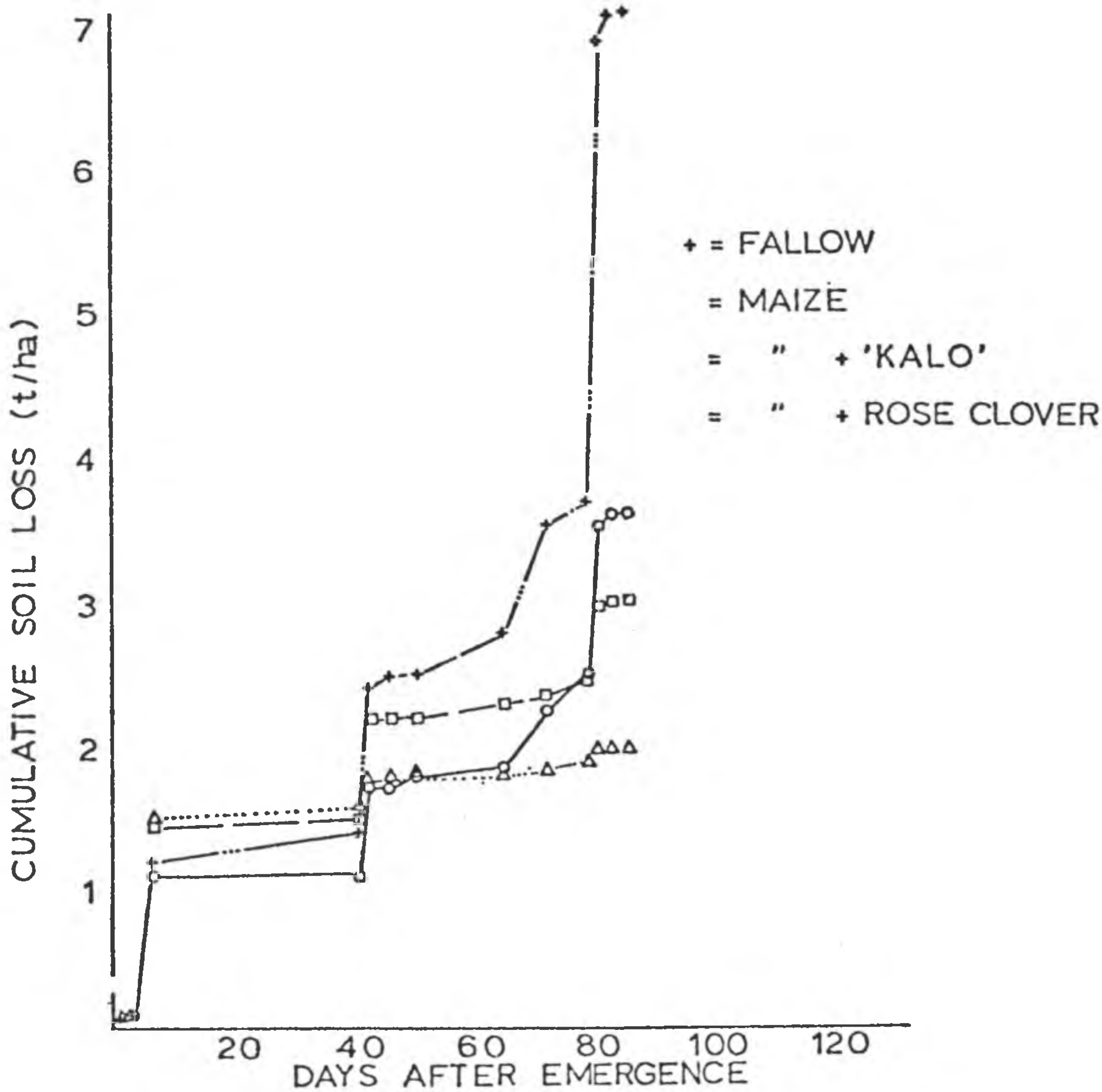
w--z: p=0.20

Effect of vegetative cover on soil loss. The vegetative cover had significant effects on cumulative soil loss during the crop's growth period. The means (Table 18) showed significant differences between fallow, maize, and maize + rose clover at an 80% probability level. Differences between the two legume covers were not statistically significant. Qualitatively, the observed trends of soil losses were in the order: fallow > maize > maize + 'kalo' > maize + rose clover.

The combined soil losses for all nitrogen levels are expressed on a cumulative basis over an 86-day period (Figure 8). The soil loss trends were first evaluated against cover on an individual storm basis, but the trends were not conclusively clear because of the spatial variability and other environmental factors affecting soil loss. Wischmeier and Smith (1978) stated that the USLE will not apply to estimates of soil loss for individual storms because of the many interactions with variables that change randomly over time. In the same manner, the soil loss from individual storms did not always conform to the trends shown in Figure 8. The trends of soil loss uncorrected for topographical differences are shown in Figure 9. A comparison with Figure 8 shows no difference in the relationship of soil loss with either method because of the relatively uniform topography in the field.

Despite the clear differences between soil loss and

Figure 9. Cumulative Soil Loss on Natural Slope



the vegetative treatments, an attempt to quantify soil loss as a function of percent cover resulted in a non-linear regression coefficient of less than 0.10. This low correlation may be due to the limited range of vegetative cover values (either very low or very high) and the great variability of soil loss at a specific cover value (Appendix C). Large storms with very high EI_{30} values and causing high runoff volumes seemed to greatly affect the precision of sampling. The sampling method described in the Materials and Methods section may need improvements or more replications, as indicated by the high value for the coefficient of variation (60%) in Table 17.

The 'C' factor. Factors similar to the cropping and management factor of the USLE were calculated for the vegetative cover treatments. Using the soil losses from the fallow treatment as a basis of computation (C=1 if the fallow and vegetative treatments have equivalent soil losses), the respective factors for maize, maize + 'kalo', and maize + rose clover are: 0.52, 0.40, and 0.29 based on their soil loss ratios, respectively. These factors indicate that the addition of vegetative cover will reduce soil loss with respect to the fallow plots by 48, 60, and 71% for maize, maize + 'kalo', and maize + rose clover, respectively. But the reduction in soil losses are only valid during the season and under the rainfall erosivity distribution pattern which prevailed in this study. The calculated factors indicate the ability of the specific vegetative cover combinations to reduce soil loss and do not represent the actual cropping and management factors (C) for the application in the USLE, which is a mean annual value for each specific cropping system.

Summary. Vegetative cover greatly decreased soil loss. The use of maize + rose clover reduced soil loss by 44% in comparison to the maize treatment alone. The nitrogen fertilization rates had no effect on soil loss, probably because of the high application rates.

SUMMARY AND CONCLUSIONS

The major objectives of this study were to examine the effects of three nitrogen rates and two intercropped legumes ('kalo' and rose clover) on maize yield, runoff, and soil loss on a tropical Aridisol.

The nitrogen fertilization rates ranging from 95 to 570 kg N/ha significantly increased maize grain and stover yields between 95-190 and 190-380 kg N/ha for the first and second plantings, respectively. A composite response curve for all maize-legume combinations showed the optimum N rate for grain yield to be between 190-200 kg N/ha. The intercropping of rose clover significantly reduced grain yield in the first planting only. The second planting was not significantly affected by the intercropped legumes.

The stover yield responded to the nitrogen treatments, but the results appeared confounded by the strong winds prior to both harvests which blew away the leaves.

Despite a crop yield response to the nitrogen fertilization treatments, no significant effects of fertilization were noted on runoff and soil loss. The vegetative cover significantly affected the runoff and soil losses. The measured runoff expressed as percent of the total rainfall for the fallow, maize, maize + 'kalo', and maize + rose clover were 19.0, 16.4, 15.6, and 13.1%, respectively. A comparison of the vegetative plots to the fallow plot revealed the following reductions in runoff for maize, maize + 'kalo', and maize + rose clover: 13, 17, and 31%, respectively.

The vegetative cover also reduced the soil loss significantly. Maize reduced soil loss by 48%, and maize + rose clover by 71% in comparison with fallow. These values will be useful for establishing mean annual C factors involving maize cropping under tropical conditions.

The use of intercropped legumes can provide multiple benefits to farmers in the developing countries. The legumes can provide protection from water losses by runoff, soil losses by erosion, and may act as a source of nitrogen to the soil. The latter benefit appears more prominantly in subsequent cropping cycles.

APPENDICES

APPENDIX A

APPENDIX A

Table 19. Leaf Analysis of Maize--First Planting (November 1978)

N Rates kg/ha	Treatment	Rep	N %	P %	K %	Ca %	Mg %	S %	Si %	Na %	Cl %	Al ppm	Mn ppm	Fe ppm	Cu ppm	Zn ppm
			Elements Analyzed													
190	Maize	1	2.98	0.30	2.00	0.36	0.23	0.20	0.82	0.13	0.62	100	138	117	15	43
		2	2.98	0.31	1.90	0.37	0.20	0.18	0.96	0.14	0.57	71	110	116	14	9
		3	2.90	0.31	2.01	0.36	0.24	0.18	0.84	0.14	0.59	62	140	103	16	44
		4	2.93	0.32	1.91	0.35	0.24	0.18	0.93	0.15	0.61	79	93	115	14	33
		Mean	2.95	0.31	1.96	0.36	0.23	0.18	0.89	0.14	0.60	78	120	113	15	33
	'Kalo'	1	2.85	0.31	2.15	0.37	0.22	0.20	0.86	0.13	0.65	85	132	122	16	44
		2	3.06	0.32	1.91	0.40	0.22	0.19	0.92	0.14	0.57	63	112	111	14	40
		3	3.05	0.30	2.11	0.37	0.21	0.19	0.90	0.14	0.66	81	142	106	17	45
		4	2.70	0.29	1.84	0.37	0.24	0.18	1.22	0.14	0.63	95	131	116	12	38
		Mean	2.92	0.30	2.00	0.38	0.22	0.19	0.98	0.14	0.63	81	129	114	15	42
	Rose clover	1	2.70	0.29	1.89	0.35	0.23	0.18	0.78	0.14	0.54	183	117	113	14	39
		2	2.89	0.31	1.99	0.40	0.24	0.19	0.96	0.13	0.63	100	111	109	13	39
		3	2.60	0.31	1.97	0.30	0.20	0.17	0.78	0.13	0.58	69	112	109	14	39
		4	2.79	0.30	1.79	0.33	0.25	0.17	0.82	0.15	0.56	110	102	130	12	33
		Mean	2.74	0.30	1.91	0.34	0.23	0.18	0.84	0.14	0.58	116	110	115	13	38
380	Maize	1	3.10	0.31	2.07	0.36	0.22	0.21	0.70	0.14	0.64	85	119	116	15	41
		2	2.90	0.30	2.05	0.36	0.24	0.19	0.81	0.14	0.63	80	118	118	14	40
		3	3.22	0.32	2.13	0.31	0.19	0.19	0.66	0.14	0.58	94	89	131	16	37
		4	3.14	0.34	1.95	0.35	0.21	0.21	1.00	0.13	0.55	72	95	118	15	42
		Mean	3.10	0.32	2.05	0.34	0.22	0.20	0.79	0.14	0.60	83	105	121	15	40
	'Kalo'	1	2.69	0.31	1.82	0.36	0.24	0.19	0.81	0.15	0.53	85	116	121	14	40
		2	2.72	0.31	1.91	0.37	0.26	0.19	0.87	0.15	0.58	84	129	117	14	47
		3	3.14	0.31	1.97	0.37	0.21	0.19	0.79	0.12	0.58	85	114	118	15	40
		4	3.04	0.35	1.93	0.36	0.23	0.20	1.38	0.13	0.53	85	115	110	14	43
		Mean	2.90	0.32	1.91	0.36	0.24	0.19	0.96	0.14	0.56	85	118	116	14	42
	Rose clover	1	3.01	0.32	1.84	0.38	0.23	0.20	0.95	0.14	0.52	248	123	121	15	42
		2	2.94	0.29	1.88	0.37	0.24	0.19	0.83	0.16	0.61	85	137	115	14	42
		3	3.06	0.29	1.99	0.34	0.20	0.20	0.70	0.15	0.57	69	140	110	15	46
		4	3.02	0.34	1.86	0.34	0.23	0.19	0.96	0.14	0.52	49	107	108	16	42
		Mean	3.01	0.31	1.89	0.36	0.23	0.20	0.86	0.15	0.56	113	127	114	15	43
570	Maize	1	3.17	0.32	1.99	0.34	0.20	0.19	0.86	0.15	0.57	135	128	125	15	37
		2	3.06	0.30	2.00	0.40	0.23	0.20	0.81	0.14	0.63	87	142	120	15	44
		3	3.16	0.31	2.02	0.35	0.21	0.20	0.85	0.12	0.58	61	116	110	15	36
		4	3.29	0.33	1.92	0.35	0.22	0.19	1.10	0.14	0.50	107	102	125	15	38
		Mean	3.17	0.32	1.98	0.36	0.22	0.20	0.90	0.14	0.57	98	122	120	15	39
	'Kalo'	1	3.27	0.29	2.14	0.35	0.20	0.20	0.86	0.14	0.69	82	111	117	14	37
		2	3.26	0.32	2.07	0.37	0.20	0.19	0.92	0.15	0.59	71	104	115	16	41
		3	3.05	0.32	2.17	0.35	0.21	0.20	1.09	0.14	0.63	197	124	126	17	50
		4	3.23	0.33	1.75	0.39	0.23	0.19	1.05	0.13	0.50	61	98	113	14	37
		Mean	3.20	0.32	2.03	0.36	0.21	0.20	0.98	0.14	0.60	103	109	118	15	41
	Rose clover	1	3.08	0.31	1.97	0.35	0.20	0.20	0.93	0.14	0.58	73	117	115	14	41
		2	3.03	0.32	1.99	0.36	0.22	0.18	0.85	0.14	0.56	55	123	110	14	39
		3	3.05	0.30	2.08	0.33	0.18	0.19	0.99	0.12	0.62	69	113	112	14	36
		4	3.18	0.31	1.85	0.32	0.21	0.18	0.91	0.14	0.50	60	96	115	15	39
		Mean	3.08	0.31	1.97	0.34	0.20	0.19	0.92	0.14	0.56	64	112	113	14	39

APPENDIX A

Table 20. Leaf Tissue Analysis--Second Planting (July 1979)

N Rates (kg/ha)	Treatment	Rep	N %	P %	K %	Ca %	Mg %	S %	Si %	Na %	Cl %	Al ppm	Mn ppm	Fe ppm	Cu ppm	Zn ppm
95	Maize	1	2.20	0.26	1.89	0.37	0.29	0.13	0.77	0.07	0.61	126	116	114	12	28
		2	2.18	0.27	1.90	0.31	0.26	0.12	1.45	0.06	0.64	91	99	109	12	29
		3	2.30	0.26	1.85	0.34	0.25	0.14	1.50	0.06	0.77	115	93	122	11	32
		4	2.12	0.24	1.99	0.29	0.24	0.12	1.21	0.07	0.74	164	98	136	11	27
	'Kalo'	1	1.97	0.24	1.77	0.38	0.30	0.12	0.89	0.07	0.48	92	122	112	11	29
		2	2.43	0.30	1.94	0.34	0.27	0.14	1.18	0.06	0.69	106	103	118	13	30
		3	2.00	0.26	2.06	0.32	0.27	0.13	0.83	0.05	0.73	93	97	111	12	28
		4	2.05	0.27	1.93	0.29	0.23	0.12	1.41	0.05	0.71	123	87	132	11	28
	Rose clover	1	2.44	0.27	1.95	0.34	0.27	0.15	0.91	0.06	0.75	239	101	123	15	32
		2	2.41	0.31	2.07	0.31	0.26	0.14	1.13	0.06	0.74	236	103	121	13	31
		3	2.54	0.29	1.91	0.31	0.24	0.15	1.35	0.07	0.83	116	75	116	13	30
		4	2.26	0.29	2.01	0.31	0.25	0.14	1.46	0.06	0.77	163	81	136	12	28
190	Maize	1	2.83	0.31	2.20	0.32	0.26	0.16	0.76	0.07	0.83	88	94	117	16	37
		2	3.02	0.33	2.16	0.31	0.25	0.16	1.20	0.07	0.82	228	91	119	16	35
		3	2.64	0.32	2.14	0.30	0.24	0.16	1.15	0.07	0.85	98	98	129	14	36
		4	2.61	0.35	2.16	0.31	0.23	0.16	1.48	0.06	0.86	185	113	133	13	32
	'Kalo'	1	2.83	0.31	2.29	0.30	0.24	0.16	0.73	0.07	0.84	99	94	119	16	36
		2	2.71	0.32	2.23	0.30	0.23	0.16	1.06	0.07	0.88	81	86	121	15	37
		3	2.84	0.31	2.17	0.29	0.21	0.15	1.05	0.06	0.90	165	81	138	14	33
		4	2.61	0.35	2.07	0.30	0.23	0.15	1.63	0.06	0.80	127	96	130	13	39
	Rose clover	1	2.71	0.29	2.30	0.32	0.26	0.17	0.93	0.07	0.88	129	99	120	17	39
		2	2.51	0.31	2.40	0.27	0.23	0.15	0.83	0.07	0.92	105	97	121	15	35
		3	2.57	0.36	2.18	0.29	0.23	0.16	1.07	0.07	0.82	130	89	132	16	36
		4	2.64	0.35	2.20	0.32	0.23	0.16	1.40	0.05	0.84	138	89	134	14	30
285	Maize	1	2.98	0.34	2.26	0.31	0.24	0.17	1.12	0.07	0.85	121	111	133	16	41
		2	2.85	0.37	2.31	0.31	0.25	0.15	0.87	0.06	0.73	93	113	119	16	38
		3	2.64	0.37	2.29	0.32	0.25	0.16	1.41	0.07	0.83	112	101	127	14	33
		4	2.60	0.33	2.14	0.30	0.23	0.16	1.22	0.06	0.81	178	104	133	14	33
	'Kalo'	1	2.88	0.35	2.41	0.30	0.25	0.16	0.77	0.07	0.78	109	111	134	17	46
		2	2.70	0.36	2.22	0.31	0.22	0.15	1.46	0.06	0.84	188	91	126	14	32
		3	2.77	0.37	2.16	0.30	0.22	0.16	1.48	0.06	0.81	113	102	130	15	37
		4	2.72	0.35	2.22	0.29	0.22	0.16	1.40	0.05	0.86	169	84	127	14	32
	Rose clover	1	2.98	0.35	2.34	0.31	0.25	0.16	0.88	0.07	0.79	92	97	128	17	41
		2	2.60	0.35	2.19	0.28	0.23	0.16	1.15	0.07	0.83	101	113	123	18	39
		3	2.72	0.36	2.10	0.29	0.23	0.14	1.30	0.06	0.67	102	86	123	14	33
		4	2.67	0.35	2.21	0.32	0.24	0.16	1.38	0.06	0.82	510	98	140	15	38

APPENDIX A

Table 21. P and K Uptake in the Maize Grain--First Planting (November 1978)

N Rate kg/ha	Treatment	Rep	P %	K %
190	Maize	1	.33	.15
		2	.40	.16
		3	.50	.22
		4	.44	.20
		Mean	.38	.17
	'Kalo'	1	.36	.19
		2	.45	.20
		3	.56	.25
		4	.40	.18
		Mean	.39	.18
	Rose clover	1	.40	.19
		2	.43	.22
		3	.49	.22
		4	.49	.20
		Mean	.39	.18
280	Maize	1	.42	.21
		2	.45	.21
		3	.48	.21
		4	.51	.22
		Mean	.46	.21
	'Kalo'	1	.32	.16
		2	.43	.16
		3	.50	.20
		4	.57	.24
		Mean	.44	.18
	Rose clover	1	.36	.18
		2	.46	.21
		3	.49	.19
		4	.80	.49
		Mean	.49	.25
580	Maize	1	.42	.19
		2	.56	.25
		3	.46	.20
		4	.47	.22
		Mean	.48	.22
	'Kalo'	1	.42	.22
		2	.50	.19
		3	.52	.28
		4	.52	.23
		Mean	.48	.22
	Rose clover	1	.41	.19
		2	.56	.23
		3	.48	.23
		4	.47	.22
		Mean	.48	.21

APPENDIX A

Table 22. Normal Range of Element Concentration in the Ear Leaf at Silking

Element		Ear Leaf at Silking
N		2.7 - 3.5
P		0.2 - 0.4
K		1.7 - 2.5
Ca	%	0.4 - 1.0
Mg		0.2 - 0.4
S		0.1 - 0.3
Al		10 - 200
B		4 - 15
Cu		3 - 15
Fe		50 - 200
Mn	ppm	20 - 250
Na		1 - 400
Sr		10 - 100

Source: J. B. Jones, Ohio Plant Analysis Laboratory, Wooster, Ohio, 1965-1969

APPENDIX B

APPENDIX B

Table 23. 'LS', Slope, and Area of Individual Plots

N Rate	Ground Cover Treatment	Plot No.	Area sq m	Slope %	SL Factor
190 kg N/ha	Fallow	1	9.00	7.06	0.37
		2	8.96	5.39	0.26
		3	9.19	6.15	0.31
		4	8.95	6.25	0.32
	Maize	5	9.02	6.40	0.33
		6	8.89	4.98	0.24
		7	8.89	5.69	0.28
		8	8.64	6.50	0.33
	'Kalo'	9	8.95	6.86	0.36
		10	9.04	5.74	0.28
		11	9.00	5.95	0.30
		12	8.39	6.30	0.32
	Rose clover	13	9.00	6.25	0.32
		14	8.96	5.89	0.29
		15	9.10	6.45	0.33
		16	8.23	6.00	0.30
380 kg N/ha	Fallow	17	9.05	5.64	0.28
		18	8.82	6.45	0.33
		19	9.05	6.45	0.33
		20	9.20	4.93	0.24
	Maize	21	8.98	5.64	0.28
		22	8.86	6.05	0.30
		23	9.07	6.50	0.33
		24	8.35	5.28	0.26
	'Kalo'	25	8.97	5.79	0.29
		26	8.83	5.34	0.26
		27	9.20	5.49	0.27
		28	8.84	5.03	0.24
	Rose clover	29	8.85	6.35	0.32
		30	8.83	5.89	0.29
		31	9.11	5.84	0.29
		32	8.87	5.13	0.25
570 kg N/ha	Fallow	33	8.90	5.69	0.28
		34	9.01	6.40	0.33
		35	8.82	5.08	0.24
		36	9.06	6.15	0.31
	Maize	37	8.97	5.95	0.30
		38	8.87	6.91	0.36
		39	9.05	5.03	0.24
		40	9.00	7.01	0.37
	'Kalo'	41	8.92	5.95	0.30
		42	9.15	6.05	0.30
		43	8.78	5.23	0.25
		44	9.17	6.91	0.36
	Rose clover	45	9.06	5.74	0.28
		46	8.92	6.61	0.34
		47	8.92	4.67	0.22
		48	9.08	6.71	0.35

APPENDIX C

APPENDIX C

Table 24. Individual Storm Data With Rainfall Intensity, Vegetative Cover, Runoff, and Soil Loss

STORM NO.: 1 DATE: 12/ 4/78 RAINFALL(MM): 11.4 EI30(METRIC): 1.7

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	24.1	2.7	0.20	0.0053	0.0143	0	0
2	17.5	2.0	0.35	0.0069	0.0265	0	0
3	2.0	0.2	2.60	0.0057	0.0184	0	0
4	2.6	0.3	9.65	0.0280	0.0875	0	0
5	1.7	0.2	3.71	0.0070	0.0212	7	0
6	1.7	0.2	1.18	0.0022	0.0092	7	0
7	1.6	0.2	15.44	0.0278	0.0993	7	0
8	2.1	0.2	23.76	0.0578	0.1752	7	0
9	1.8	0.2	5.22	0.0105	0.0292	7	1
10	0.8	0.1	2.25	0.0020	0.0071	7	3
11	1.9	0.2	10.58	0.0223	0.0743	7	1
12	2.1	0.3	2.62	0.0066	0.0206	7	2
13	1.5	0.2	4.00	0.0067	0.0209	7	4
14	1.6	0.2	1.37	0.0025	0.0086	7	4
15	2.0	0.2	4.95	0.0109	0.0330	7	12
16	1.8	0.2	5.39	0.0118	0.0393	7	13
17	2.0	0.2	4.90	0.0108	0.0386	0	0
18	2.0	0.2	6.50	0.0193	0.0585	0	0
19	0.5	0.1	8.00	0.0044	0.0133	0	0
20	1.6	0.2	13.37	0.0233	0.0971	0	0
21	2.3	0.3	5.43	0.0139	0.0496	7	0
22	1.8	0.2	9.00	0.0183	0.0610	7	0
23	0.7	0.1	33.86	0.0261	0.0791	7	0
24	1.6	0.2	16.01	0.0194	0.0746	7	0
25	0.8	0.1	2.12	0.0019	0.0066	7	1
26	1.8	0.2	2.44	0.0050	0.0192	7	1
27	0.5	0.1	2.80	0.0015	0.0056	7	1
28	1.5	0.2	7.47	0.0127	0.0529	7	1
29	1.6	0.2	4.95	0.0094	0.0294	7	2
30	1.8	0.2	4.44	0.0091	0.0314	7	13
31	1.1	0.1	3.45	0.0042	0.0145	7	7
32	1.9	0.2	6.95	0.0149	0.0596	7	10
33	2.6	0.3	4.96	0.0134	0.0479	0	0
34	2.1	0.2	5.14	0.0120	0.0364	0	0
35	2.1	0.2	6.38	0.0152	0.0633	0	0
36	3.5	0.4	3.37	0.0130	0.0419	0	0
37	3.8	0.4	4.68	0.0198	0.0660	7	0
38	1.7	0.2	4.18	0.0080	0.0222	7	0
39	1.6	0.2	24.87	0.0440	0.1833	7	0
40	2.3	0.3	7.00	0.0179	0.0484	7	0
41	1.8	0.2	4.89	0.0099	0.0330	7	2
42	2.1	0.2	3.38	0.0078	0.0260	7	1
43	1.5	0.2	4.47	0.0076	0.0304	7	1
44	1.9	0.2	4.11	0.0085	0.0236	7	1
45	2.0	0.2	2.05	0.0045	0.0161	7	2
46	0.8	0.1	1.38	0.0012	0.0035	7	4
47	0.8	0.1	4.13	0.0037	0.0168	7	3
48	1.6	0.2	8.37	0.0148	0.0423	7	10

Key for plots are in Appendix B.

Table 24 (continued)

STORM NO.: 2 DATE: 12/ 5/78 RAINFALL(MM): 35.6 EI30(METRIC): 4.0

PLOT	RUNOFF (LITER)	RUNOFF (MM)	SOIL LOSS CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	23.2	2.6	3.24	0.0836	0.2259	0	0
2	16.8	1.9	3.15	0.0593	0.2269	0	0
3	18.3	2.0	5.19	0.1033	0.3337	0	0
4	16.6	1.9	4.17	0.0773	0.2416	0	0
5	13.4	1.5	2.78	0.0470	0.1424	8	0
6	17.4	2.0	2.22	0.0435	0.1812	8	0
7	7.3	0.8	1.30	0.0107	0.0382	8	0
8	15.6	1.5	4.81	0.0869	0.2633	8	0
9	14.8	1.7	6.30	0.1041	0.2492	8	1
10	11.6	1.3	2.31	0.0296	0.1057	8	3
11	9.0	1.0	2.41	0.0241	0.0803	8	1
12	11.0	1.3	6.95	0.0911	0.2847	8	2
13	12.5	1.4	5.18	0.0720	0.2250	8	4
14	5.4	0.6	1.85	0.0112	0.0386	8	4
15	7.7	0.8	2.06	0.0175	0.0530	8	12
16	8.0	1.0	3.05	0.0296	0.0987	8	13
17	15.8	1.7	1.85	0.0485	0.1732	0	0
18	7.3	0.9	1.48	0.0122	0.0370	0	0
19	3.2	0.4	0.84	0.0030	0.0091	0	0
20	37.0	4.0	3.24	0.1303	0.5429	0	0
21	23.6	2.6	3.89	0.1022	0.3650	8	0
22	8.2	0.9	5.37	0.0497	0.1657	8	0
23	3.2	0.4	1.47	0.0052	0.0159	8	0
24	11.7	1.3	3.38	0.0524	0.2015	8	0
25	21.6	2.4	5.56	0.1338	0.4614	8	1
26	10.1	1.1	2.59	0.0297	0.1142	8	1
27	4.6	0.5	1.67	0.0084	0.0311	8	1
28	31.4	3.6	2.59	0.0921	0.3338	8	1
29	30.7	3.5	5.56	0.1928	0.6025	8	2
30	9.9	1.1	2.79	0.0311	0.1072	8	13
31	5.4	0.6	1.48	0.0089	0.0303	8	7
32	50.8	5.7	2.22	0.1273	0.5092	8	10
33	32.5	3.7	5.56	0.2029	0.7246	0	0
34	14.7	1.6	4.07	0.0665	0.2015	0	0
35	36.4	4.1	3.15	0.1299	0.5412	0	0
36	56.0	6.2	2.69	0.1660	0.5355	0	0
37	25.5	2.8	3.05	0.0868	0.2893	8	0
38	22.9	2.6	2.22	0.0574	0.1594	8	0
39	30.8	3.4	3.70	0.1251	0.5254	8	0
40	45.5	5.1	3.70	0.1872	0.5059	8	0
41	14.4	1.6	7.15	0.1154	0.3347	8	2
42	14.1	1.5	3.06	0.0471	0.1570	8	1
43	35.2	4.0	1.85	0.0743	0.2972	8	1
44	23.9	2.6	4.08	0.1062	0.2950	8	1
45	14.1	1.6	3.70	0.0576	0.2057	8	2
46	14.5	1.6	1.30	0.0211	0.0621	8	4
47	14.0	1.6	1.66	0.0261	0.1186	8	3
48	16.2	1.8	5.74	0.1024	0.2926	8	10

STORM NO.: 3 DATE: 12/ 6/78 RAINFALL(MM): 8.4 EI30(METRIC): 0.3

PLOT	RUNOFF (LITER)	RUNOFF (MM)	SOIL LOSS CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	0.6	0.1	2.17	0.0014	0.0035	0	0
2	1.4	0.2	4.14	0.0065	0.0250	0	0
3	1.6	0.2	11.25	0.0196	0.0632	0	0
4	1.6	0.2	3.31	0.0059	0.0194	0	0
5	1.2	0.1	3.58	0.0048	0.0145	8	0
6	1.3	0.1	1.08	0.0016	0.0067	8	0
7	1.4	0.2	0.36	0.0006	0.0021	8	0
8	1.9	0.2	20.26	0.0446	0.1352	8	0
9	1.3	0.1	2.31	0.0034	0.0094	8	1
10	0.4	0.0	3.25	0.0014	0.0050	8	3
11	1.5	0.2	3.67	0.0061	0.0203	8	1
12	1.1	0.1	3.08	0.0036	0.0112	8	2
13	1.4	0.2	5.86	0.0091	0.0284	8	4
14	1.2	0.1	1.33	0.0018	0.0062	8	4
15	1.8	0.2	1.17	0.0023	0.0070	8	12
16	1.6	0.2	8.19	0.0159	0.0530	8	13
17	1.5	0.2	1.33	0.0022	0.0077	0	0
18	1.6	0.2	1.69	0.0031	0.0094	0	0
19	0.1	0.0	1.00	0.0001	0.0003	0	0
20	1.8	0.2	14.67	0.0287	0.1196	0	0
21	1.4	0.2	3.79	0.0059	0.0211	8	0
22	1.2	0.1	9.17	0.0124	0.0413	8	0
23	0.3	0.0	1.33	0.0004	0.0012	8	0
24	1.1	0.1	5.45	0.0072	0.0277	8	0
25	0.5	0.1	3.80	0.0021	0.0072	8	1
26	1.4	0.2	0.96	0.0014	0.0054	8	1
27	0.1	0.0	0.0	0.0	0.0	8	1
28	1.4	0.2	21.00	0.0333	0.1387	8	1
29	1.7	0.2	4.59	0.0083	0.0275	8	2
30	1.5	0.2	0.60	0.0010	0.0034	8	13
31	1.0	0.1	0.80	0.0009	0.0031	8	7
32	1.4	0.2	1.36	0.0021	0.0084	8	10
33	1.7	0.2	5.38	0.0097	0.0346	0	0
34	1.7	0.2	2.29	0.0043	0.0130	0	0
35	1.6	0.2	2.19	0.0040	0.0167	0	0
36	0.1	0.0	18.00	0.0020	0.0065	0	0
37	1.5	0.2	1.80	0.0030	0.0100	8	0
38	1.5	0.2	2.33	0.0039	0.0108	8	0
39	1.5	0.2	2.22	0.0037	0.0154	8	0
40	1.5	0.2	2.53	0.0042	0.0114	8	0
41	1.7	0.2	27.29	0.0520	0.1733	8	2
42	1.8	0.2	6.78	0.0133	0.0443	8	1
43	1.2	0.1	0.0	0.0	0.0	8	1
44	1.3	0.1	14.31	0.0203	0.0564	8	1
45	1.7	0.2	5.24	0.0098	0.0350	8	2
46	0.7	0.1	2.14	0.0017	0.0050	8	4
47	0.5	0.1	2.60	0.0015	0.0060	8	3
48	1.4	0.2	8.57	0.0132	0.0377	8	10

Key for plots are in Appendix B.

Table 24 (continued)

STORM NO.: 4 DATE: 12/ 7/78 RAINFALL(MM): 34.3 EI30(METRIC): 17.9

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	103.2	11.5	8.09	0.9280	2.5081	0	0
2	101.3	11.3	15.56	1.7587	6.7642	0	0
3	106.9	11.6	11.36	1.2860	4.1484	0	0
4	109.8	12.3	13.04	1.5994	4.9901	0	0
5	91.8	10.2	3.79	0.3845	1.1652	9	0
6	104.1	11.7	7.78	0.9108	3.7950	9	0
7	87.1	9.8	3.69	0.3611	1.2396	9	0
8	100.3	11.6	31.89	3.7020	11.2182	9	0
9	103.2	11.5	8.07	0.9339	2.5859	9	1
10	111.7	12.4	7.94	0.9816	3.5357	9	3
11	109.8	12.2	5.39	0.6574	2.1913	9	1
12	89.0	10.6	58.85	6.2429	19.5090	9	2
13	89.0	9.9	5.93	0.5860	1.8312	9	4
14	90.8	10.1	8.17	0.8276	2.8534	9	4
15	90.8	10.0	4.56	0.4545	1.3773	9	12
16	93.7	11.4	23.28	2.6502	9.8340	9	13
17	107.9	11.9	7.22	0.9611	3.0754	0	0
18	100.3	11.4	3.90	0.4317	1.3032	0	0
19	37.9	4.2	12.39	0.5188	1.5721	0	0
20	113.6	12.1	2.96	0.3659	1.5246	0	0
21	101.3	11.3	4.87	0.5494	1.9621	9	0
22	85.2	9.6	15.09	1.4514	4.9380	9	0
23	72.9	8.0	16.35	1.3142	3.9824	9	0
24	111.7	13.4	7.17	0.9587	3.6973	9	0
25	102.2	11.4	2.91	0.3312	1.1421	9	1
26	101.3	11.5	29.37	3.3094	12.9592	9	1
27	52.0	5.7	16.37	0.9253	3.4270	9	1
28	111.7	12.6	2.09	0.2644	1.1017	9	1
29	103.2	11.7	4.37	0.5096	1.5925	9	2
30	101.3	11.5	24.46	2.9055	9.6776	9	13
31	84.2	9.2	31.94	2.9525	10.1813	9	7
32	111.7	12.6	4.50	0.5666	2.2664	9	10
33	89.0	13.0	29.19	2.9185	13.4232	0	0
34	100.3	11.1	5.94	0.6617	2.0052	0	0
35	111.7	12.7	7.89	0.9991	4.1629	0	0
36	113.6	12.5	6.18	0.7755	2.5016	0	0
37	90.8	10.1	8.09	0.8192	2.7307	9	0
38	106.0	12.0	2.09	0.2501	0.6947	9	0
39	110.7	12.2	2.54	0.3103	1.2929	9	0
40	110.7	12.3	6.37	0.7836	2.1179	9	0
41	113.6	12.7	8.94	1.1391	3.7973	9	2
42	114.5	12.5	4.83	0.6048	2.0160	9	1
43	111.7	12.7	3.72	0.4736	1.8944	9	1
44	110.7	12.1	9.30	1.0015	2.7819	9	1
45	102.2	11.3	39.67	4.4745	15.9804	9	2
46	100.3	11.2	3.20	0.3602	1.0594	9	4
47	102.2	11.5	2.18	0.2503	1.1377	9	3
48	109.5	12.1	11.26	1.3616	3.8903	9	10

STORM NO.: 5 DATE: 1/10/79 RAINFALL(MM): 26.9 EI30(METRIC): 2.8

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	35.5	3.9	5.33	0.2103	0.5684	0	0
2	8.9	1.0	4.81	0.0478	0.1839	0	0
3	16.8	1.8	3.82	0.0697	0.2248	0	0
4	22.7	2.5	2.59	0.0657	0.2053	0	0
5	4.5	0.5	4.13	0.0206	0.0624	89	0
6	10.9	1.2	2.60	0.0318	0.1325	89	0
7	8.9	1.0	4.06	0.0406	0.1450	89	0
8	14.8	1.7	3.11	0.0532	0.1612	89	0
9	7.5	0.8	2.68	0.0225	0.0625	89	13
10	10.6	1.2	6.39	0.0749	0.2675	89	16
11	8.0	0.9	3.96	0.0391	0.1303	89	25
12	5.9	0.7	2.81	0.0198	0.0619	89	29
13	5.8	0.6	4.38	0.0282	0.0891	89	47
14	3.3	0.4	4.76	0.0175	0.0603	89	58
15	5.3	0.6	1.04	0.0060	0.0182	89	80
16	5.6	0.7	2.16	0.0147	0.0490	89	63
17	19.0	2.1	3.37	0.0707	0.2525	0	0
18	11.9	1.3	2.13	0.0287	0.0873	0	0
19	13.2	1.5	2.70	0.0394	0.1194	0	0
20	17.9	1.9	3.34	0.0649	0.2704	0	0
21	13.3	1.5	3.76	0.0557	0.1989	89	0
22	5.5	0.6	1.96	0.0122	0.0407	89	0
23	7.6	0.8	30.00	0.2514	0.7618	89	0
24	20.0	2.4	2.37	0.0568	0.2185	89	0
25	9.3	1.0	4.89	0.0507	0.1749	89	7
26	7.0	0.9	3.63	0.0288	0.1105	89	10
27	4.9	0.5	3.22	0.0172	0.0637	89	17
28	7.8	0.9	6.85	0.0604	0.2517	89	8
29	10.4	1.2	2.22	0.0261	0.0816	89	38
30	4.5	0.5	1.93	0.0099	0.0341	89	40
31	2.6	0.3	2.46	0.0070	0.0241	89	61
32	7.0	0.8	1.40	0.0110	0.0440	89	80
33	20.0	2.2	2.35	0.0528	0.1886	0	0
34	14.0	1.6	9.81	0.1525	0.4621	0	0
35	18.7	2.1	4.33	0.0918	0.3425	0	0
36	36.9	4.1	7.44	0.3032	0.9741	0	0
37	15.3	1.7	3.24	0.0553	0.1843	89	0
38	9.9	1.1	2.18	0.0244	0.0578	89	0
39	12.2	1.3	1.97	0.0265	0.1104	89	0
40	13.1	1.5	6.78	0.0887	0.2069	89	0
41	9.1	1.0	7.63	0.0778	0.2593	89	5
42	7.0	0.8	3.13	0.0239	0.0797	89	4
43	13.5	1.5	1.96	0.0302	0.1203	89	19
44	10.0	1.1	6.85	0.0747	0.2075	89	16
45	8.0	0.9	2.59	0.0228	0.0814	89	31
46	2.9	0.3	4.53	0.0157	0.0462	89	31
47	4.1	0.5	3.12	0.0143	0.0450	89	47
48	3.6	0.4	2.31	0.0091	0.0260	89	56

Key for plots are in Appendix B.

Table 24 (continued)

STORM NO.: 6 DATE: 1/11/79 RAINFALL(MM): 2.8 EI30(METRIC): 0.0

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	0.1	0.0	0.0	0.0	0.0	0	0
2	0.7	0.1	0.0	0.0	0.0	0	0
3	0.9	0.1	0.0	0.0	0.0	0	0
4	0.7	0.1	0.0	0.0	0.0	0	0
5	0.2	0.0	0.0	0.0	0.0	89	0
6	0.7	0.1	0.0	0.0	0.0	89	0
7	0.6	0.1	0.0	0.0	0.0	89	0
8	0.8	0.1	0.0	0.0	0.0	89	0
9	0.6	0.1	0.0	0.0	0.0	89	13
10	0.2	0.0	0.0	0.0	0.0	89	16
11	0.7	0.1	0.0	0.0	0.0	89	25
12	0.8	0.1	0.0	0.0	0.0	89	29
13	0.6	0.1	0.0	0.0	0.0	89	47
14	0.5	0.1	0.0	0.0	0.0	89	58
15	0.7	0.1	0.0	0.0	0.0	89	80
16	0.8	0.1	0.0	0.0	0.0	89	63
17	0.7	0.1	0.0	0.0	0.0	0	0
18	0.7	0.1	0.0	0.0	0.0	0	0
19	0.4	0.0	0.0	0.0	0.0	0	0
20	0.5	0.1	0.0	0.0	0.0	0	0
21	0.6	0.1	0.0	0.0	0.0	89	0
22	0.4	0.0	0.0	0.0	0.0	89	0
23	0.1	0.0	0.0	0.0	0.0	89	0
24	0.6	0.1	0.0	0.0	0.0	89	0
25	0.2	0.0	0.0	0.0	0.0	89	7
26	0.4	0.0	0.0	0.0	0.0	89	10
27	0.1	0.0	0.0	0.0	0.0	89	17
28	0.0	0.0	0.0	0.0	0.0	89	8
29	0.5	0.1	0.0	0.0	0.0	89	38
30	0.4	0.0	0.0	0.0	0.0	89	40
31	0.2	0.0	0.0	0.0	0.0	89	61
32	0.7	0.1	0.0	0.0	0.0	89	80
33	0.3	0.0	0.0	0.0	0.0	0	0
34	0.8	0.1	0.0	0.0	0.0	0	0
35	0.9	0.1	0.0	0.0	0.0	0	0
36	0.1	0.0	0.0	0.0	0.0	0	0
37	0.8	0.1	0.0	0.0	0.0	89	0
38	0.6	0.1	0.0	0.0	0.0	89	0
39	0.7	0.1	0.0	0.0	0.0	89	0
40	0.4	0.0	0.0	0.0	0.0	89	0
41	0.7	0.1	0.0	0.0	0.0	89	5
42	0.6	0.1	0.0	0.0	0.0	89	4
43	0.6	0.1	0.0	0.0	0.0	89	19
44	0.3	0.0	0.0	0.0	0.0	89	16
45	0.5	0.1	0.0	0.0	0.0	89	31
46	0.1	0.0	0.0	0.0	0.0	89	31
47	0.4	0.0	0.0	0.0	0.0	89	47
48	0.4	0.0	0.0	0.0	0.0	89	56

STORM NO.: 7 DATE: 1/12/79 RAINFALL(MM): 75.4 EI30(METRIC): 26.0

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	105.8	11.8	8.11	0.9530	2.5757	0	0
2	110.6	12.3	6.39	0.7886	3.0331	0	0
3	115.2	12.5	22.39	2.8071	9.0552	0	0
4	116.7	13.0	11.32	1.4762	4.6131	0	0
5	110.3	12.2	9.61	1.1748	3.5633	89	0
6	118.4	13.3	0.46	0.0616	0.2567	89	0
7	94.6	10.6	5.50	0.5853	2.0774	89	0
8	96.8	11.2	2.96	0.3321	1.0364	89	0
9	102.8	11.5	10.11	1.1613	3.2258	89	13
10	99.5	11.0	10.35	1.1394	4.3693	89	16
11	119.9	13.3	2.36	0.3139	1.0460	89	25
12	103.7	12.4	1.11	0.1373	0.4291	89	29
13	92.6	10.3	2.32	0.2399	0.7466	89	47
14	104.3	11.6	0.30	0.0345	0.1190	89	58
15	100.2	11.0	3.07	0.3392	1.0248	89	80
16	91.6	11.1	1.75	0.1949	0.6493	89	63
17	104.9	11.6	8.33	0.9660	3.4500	0	0
18	113.7	12.9	4.54	0.5849	1.7724	0	0
19	113.4	12.5	0.54	0.0673	0.2039	0	0
20	106.3	11.6	7.07	0.8171	3.4046	0	0
21	80.9	9.0	6.18	0.5566	1.9877	89	0
22	97.8	11.0	3.70	0.4049	1.3627	89	0
23	107.0	11.8	3.30	0.3889	1.1735	89	0
24	93.9	11.2	7.76	0.8726	3.3562	89	0
25	90.2	10.1	4.54	0.4561	1.5728	89	7
26	102.5	11.6	1.29	0.1493	0.5742	89	10
27	96.9	10.5	1.93	0.2028	0.7511	89	17
28	91.2	10.3	4.46	0.4605	1.9187	89	8
29	98.1	11.1	0.93	0.1329	0.3216	89	38
30	106.0	12.0	3.25	0.3901	1.3452	89	40
31	97.5	10.7	3.06	0.3270	1.1276	89	61
32	104.4	12.3	0.46	0.3573	0.2292	89	80
33	115.9	13.0	6.04	0.7862	2.8079	0	0
34	98.4	10.9	5.75	0.6280	1.9930	0	0
35	107.5	12.2	11.96	1.4580	6.0750	0	0
36	108.5	12.1	5.61	0.6783	2.1841	89	0
37	105.5	11.6	8.89	1.0355	3.4517	0	0
38	105.5	11.9	4.39	0.5224	1.4511	89	0
39	120.2	13.3	2.57	0.3415	1.4729	89	0
40	107.3	11.9	10.32	1.2306	3.3259	89	0
41	97.6	10.9	4.57	0.5002	1.6673	89	5
42	99.2	10.8	7.54	0.8169	2.7230	89	4
43	120.4	13.7	0.39	0.0533	0.2132	89	19
44	104.3	11.4	21.14	2.4048	6.6403	89	16
45	110.3	12.2	1.50	0.1826	0.6521	89	31
46	109.0	12.2	3.32	0.4058	1.1735	89	31
47	102.5	11.5	1.00	0.1149	0.5223	89	47
48	107.6	11.8	2.43	0.2878	0.3223	89	56

Key for plots are in Appendix B .

Table 24 (continued)

STORM NO.: 8 DATE: 1/15/79 RAINFALL(MM): 15.0 EI30(METRIC): 0.3

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	2.5	0.3	0.0	0.0	0.0	0	0
2	1.6	0.2	0.0	0.0	0.0	0	0
3	5.7	0.6	0.0	0.0	0.0	0	0
4	4.6	0.5	0.0	0.0	0.0	0	0
5	0.9	0.1	0.0	0.0	0.0	91	0
6	1.6	0.2	0.0	0.0	0.0	91	0
7	1.2	0.1	0.0	0.0	0.0	91	0
8	1.8	0.2	0.0	0.0	0.0	91	0
9	1.8	0.2	0.0	0.0	0.0	91	17
10	0.7	0.1	0.0	0.0	0.0	91	20
11	1.5	0.2	0.0	0.0	0.0	91	28
12	1.9	0.2	0.0	0.0	0.0	91	33
13	1.6	0.2	0.0	0.0	0.0	91	55
14	1.4	0.2	0.0	0.0	0.0	91	67
15	1.4	0.2	0.0	0.0	0.0	91	84
16	1.6	0.2	0.0	0.0	0.0	91	73
17	4.8	0.5	0.0	0.0	0.0	0	0
18	3.5	0.4	0.0	0.0	0.0	0	0
19	2.8	0.3	0.0	0.0	0.0	0	0
20	2.6	0.3	0.0	0.0	0.0	0	0
21	1.1	0.1	0.0	0.0	0.0	91	0
22	0.9	0.1	0.0	0.0	0.0	91	0
23	0.2	0.0	0.0	0.0	0.0	91	0
24	0.6	0.1	0.0	0.0	0.0	91	0
25	0.4	0.0	0.0	0.0	0.0	91	9
26	1.3	0.1	0.0	0.0	0.0	91	8
27	0.4	0.0	0.0	0.0	0.0	91	25
28	0.6	0.1	0.0	0.0	0.0	91	14
29	1.4	0.2	0.0	0.0	0.0	91	44
30	0.9	0.1	0.0	0.0	0.0	91	43
31	0.4	0.0	0.0	0.0	0.0	91	67
32	1.1	0.1	0.0	0.0	0.0	91	87
33	2.0	0.2	0.0	0.0	0.0	0	0
34	3.2	0.4	0.0	0.0	0.0	0	0
35	2.3	0.3	0.0	0.0	0.0	0	0
36	4.2	0.5	0.0	0.0	0.0	0	0
37	1.4	0.2	0.0	0.0	0.0	91	0
38	1.4	0.2	0.0	0.0	0.0	91	0
39	1.5	0.2	0.0	0.0	0.0	91	0
40	0.8	0.1	0.0	0.0	0.0	91	0
41	1.7	0.2	0.0	0.0	0.0	91	9
42	1.6	0.2	0.0	0.0	0.0	91	4
43	1.6	0.2	0.0	0.0	0.0	91	18
44	0.6	0.1	0.0	0.0	0.0	91	22
45	1.0	0.1	0.0	0.0	0.0	91	38
46	0.2	0.0	0.0	0.0	0.0	91	36
47	1.0	0.1	0.0	0.0	0.0	91	52
48	0.8	0.1	0.0	0.0	0.0	91	63

STORM NO.: 9 DATE: 1/16/79 RAINFALL(MM): 2.3 EI30(METRIC): 0.0

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	0.1	0.0	0.0	0.0	0.0	0	0
2	0.3	0.0	0.0	0.0	0.0	0	0
3	0.4	0.0	0.0	0.0	0.0	0	0
4	0.1	0.0	0.0	0.0	0.0	0	0
5	0.2	0.0	0.0	0.0	0.0	91	0
6	0.3	0.0	0.0	0.0	0.0	91	0
7	0.2	0.0	0.0	0.0	0.0	91	0
8	0.3	0.0	0.0	0.0	0.0	91	0
9	0.0	0.0	0.0	0.0	0.0	91	17
10	0.1	0.0	0.0	0.0	0.0	91	20
11	0.3	0.0	0.0	0.0	0.0	91	28
12	0.3	0.0	0.0	0.0	0.0	91	33
13	0.3	0.0	0.0	0.0	0.0	91	55
14	0.3	0.0	0.0	0.0	0.0	91	67
15	0.3	0.0	0.0	0.0	0.0	91	84
16	0.3	0.0	0.0	0.0	0.0	91	73
17	0.3	0.0	0.0	0.0	0.0	0	0
18	0.2	0.0	0.0	0.0	0.0	0	0
19	0.2	0.0	0.0	0.0	0.0	0	0
20	0.2	0.0	0.0	0.0	0.0	0	0
21	0.1	0.0	0.0	0.0	0.0	91	0
22	0.1	0.0	0.0	0.0	0.0	91	0
23	0.1	0.0	0.0	0.0	0.0	91	0
24	0.1	0.0	0.0	0.0	0.0	91	0
25	0.1	0.0	0.0	0.0	0.0	91	9
26	0.1	0.0	0.0	0.0	0.0	91	8
27	0.1	0.0	0.0	0.0	0.0	91	25
28	0.0	0.0	0.0	0.0	0.0	91	14
29	0.2	0.0	0.0	0.0	0.0	91	44
30	0.1	0.0	0.0	0.0	0.0	91	43
31	0.1	0.0	0.0	0.0	0.0	91	67
32	0.3	0.0	0.0	0.0	0.0	91	87
33	0.2	0.0	0.0	0.0	0.0	0	0
34	0.4	0.0	0.0	0.0	0.0	0	0
35	0.4	0.0	0.0	0.0	0.0	0	0
36	0.1	0.0	0.0	0.0	0.0	0	0
37	0.2	0.0	0.0	0.0	0.0	91	0
38	0.2	0.0	0.0	0.0	0.0	91	0
39	0.4	0.0	0.0	0.0	0.0	91	0
40	0.1	0.0	0.0	0.0	0.0	91	0
41	0.2	0.0	0.0	0.0	0.0	91	9
42	0.2	0.0	0.0	0.0	0.0	91	4
43	0.2	0.0	0.0	0.0	0.0	91	18
44	0.1	0.0	0.0	0.0	0.0	91	22
45	0.2	0.0	0.0	0.0	0.0	91	38
46	0.0	0.0	0.0	0.0	0.0	91	36
47	0.2	0.0	0.0	0.0	0.0	91	52
48	0.1	0.0	0.0	0.0	0.0	91	63

Key for plots are in Appendix B.

Table 24 (continued)

STORM NO.: 10 DATE: 1/22/79 RAINFALL(MM): 28.7 EI30(METRIC): 1.0

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	54.4	6.0	2.01	0.1216	0.3286	0	0
2	35.1	3.9	2.73	0.1070	0.4115	0	0
3	65.6	7.1	2.20	0.1567	0.5055	0	0
4	47.7	5.3	2.85	0.1520	0.4750	0	0
5	14.2	1.6	1.70	0.0268	0.0812	91	0
6	11.1	1.2	1.53	0.0191	0.0796	91	0
7	30.6	3.4	1.70	0.0586	0.2093	91	0
8	32.5	3.8	0.90	0.0338	0.1024	91	0
9	23.8	2.7	1.21	0.0323	0.0997	91	21
10	11.2	1.2	2.72	0.0337	0.1234	91	27
11	16.8	1.9	1.90	0.0356	0.1187	91	35
12	21.0	2.5	0.87	0.0218	0.0681	91	33
13	5.6	0.6	0.87	0.0054	0.0169	91	58
14	3.3	0.4	1.97	0.0073	0.0252	91	72
15	4.8	0.5	0.71	0.0037	0.0112	91	84
16	3.6	0.4	2.58	0.0113	0.0377	91	76
17	50.7	5.6	1.67	0.0934	0.3336	0	0
18	42.0	4.8	1.06	0.0507	0.1536	0	0
19	35.2	3.9	1.38	0.0537	0.1627	0	0
20	59.8	6.5	2.39	0.1553	0.6471	0	0
21	32.7	3.6	0.86	0.0314	0.1121	91	0
22	20.0	2.3	1.43	0.0324	0.1090	91	0
23	20.5	2.3	1.51	0.0341	0.1133	91	0
24	34.8	4.2	1.32	0.0552	0.2123	91	0
25	24.5	2.7	0.71	0.0195	0.0672	91	10
26	25.8	2.9	1.35	0.0395	0.1519	91	4
27	18.0	2.0	1.89	0.0370	0.1370	91	20
28	20.0	2.3	4.07	0.0922	0.3842	91	19
29	10.7	1.2	1.45	0.0175	0.0547	91	47
30	5.6	0.6	1.77	0.0112	0.0386	91	45
31	2.6	0.3	1.69	0.0048	0.0166	91	68
32	3.8	0.4	1.13	0.0048	0.0192	91	87
33	54.9	6.1	4.07	0.2506	0.9236	0	0
34	49.8	5.5	3.02	0.1668	0.5055	0	0
35	52.9	6.0	2.55	0.1529	0.6371	0	0
36	62.2	6.9	6.64	0.4562	1.4716	0	0
37	43.8	4.9	1.08	0.0528	0.1760	91	0
38	29.3	3.3	2.11	0.0698	0.1939	91	0
39	21.0	2.3	0.99	0.0230	0.0958	91	0
40	34.7	3.9	0.95	0.0364	0.0934	91	0
41	28.6	3.2	0.67	0.0216	0.0720	91	14
42	21.0	2.3	0.84	0.0193	0.0643	91	4
43	19.0	2.7	2.18	0.0473	0.1592	91	17
44	15.7	1.7	7.77	0.1330	0.3694	91	26
45	16.8	1.9	1.13	0.0210	0.0753	91	43
46	3.3	0.4	1.79	0.0066	0.0194	91	39
47	4.9	0.5	1.65	0.0091	0.0414	91	54
48	3.9	0.4	4.33	0.0186	0.0531	91	65

STORM NO.: 11 DATE: 2/ 6/79 RAINFALL(MM): 55.1 EI30(METRIC): 7.8

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	108.3	12.0	1.80	0.2161	0.5841	0	0
2	111.1	12.4	1.98	0.2456	0.9446	0	0
3	103.6	11.3	3.19	0.3601	1.1616	0	0
4	113.9	12.7	2.30	0.2923	0.9134	0	0
5	115.1	12.9	0.68	0.0863	0.2615	90	0
6	112.1	12.6	0.75	0.0946	0.3942	90	0
7	100.9	11.3	1.13	0.1282	0.4579	90	0
8	101.0	11.7	1.55	0.1808	0.5479	90	0
9	111.7	12.5	0.56	0.0694	0.1929	90	25
10	112.3	12.4	1.21	0.1507	0.5382	90	35
11	105.3	11.7	0.57	0.0671	0.2237	90	37
12	90.9	10.8	1.06	0.1154	0.3636	90	34
13	67.0	7.4	0.16	0.0118	0.0369	90	58
14	36.4	4.1	0.47	0.0192	0.0662	90	70
15	65.5	7.2	0.19	0.0140	0.0424	90	77
16	36.6	4.4	0.66	0.0293	0.0977	90	72
17	137.8	15.2	2.23	0.3398	1.2136	0	0
18	106.0	12.0	1.74	0.2092	0.6339	0	0
19	111.1	12.3	1.19	0.1466	0.4442	0	0
20	113.7	12.4	0.75	0.0927	0.3862	0	0
21	99.2	11.0	1.20	0.1330	0.4750	90	0
22	98.4	11.1	0.90	0.0999	0.3327	90	0
23	100.2	11.0	1.07	0.1136	0.3594	90	0
24	101.4	12.1	2.77	0.3362	1.2931	90	0
25	106.4	11.9	0.63	0.0747	0.2576	90	13
26	100.4	11.4	1.65	0.1874	0.7209	90	5
27	95.4	10.4	0.80	0.0826	0.3059	90	20
28	111.1	12.6	1.90	0.2386	0.9942	90	29
29	109.3	12.3	0.56	0.0686	0.2144	90	46
30	68.9	7.8	0.52	0.0404	0.1393	90	44
31	57.6	6.3	0.56	0.0357	0.1231	90	62
32	85.2	9.6	0.18	0.0169	0.0676	90	75
33	104.6	11.7	2.44	0.2866	1.0236	0	0
34	97.0	10.8	2.06	0.2223	0.6736	0	0
35	105.8	12.0	2.83	0.3399	1.4162	0	0
36	111.1	12.3	2.43	0.2975	0.9597	0	0
37	107.8	12.0	0.91	0.1106	0.3687	90	0
38	104.4	11.9	0.87	0.1025	0.2847	90	0
39	103.3	11.4	0.71	0.0814	0.3392	90	0
40	115.8	12.9	1.15	0.1478	0.3925	90	0
41	107.9	12.1	0.80	0.0962	0.3207	90	20
42	106.8	11.7	1.32	0.1545	0.5150	90	4
43	104.5	11.9	0.44	0.0528	0.2112	90	24
44	90.5	9.9	1.81	0.1791	0.4975	90	30
45	91.6	10.1	0.65	0.0656	0.2343	90	45
46	76.0	8.5	0.50	0.0426	0.1253	90	39
47	90.5	10.1	0.47	0.0479	0.2177	90	54
48	64.0	7.0	0.72	0.0509	0.1454	90	56

Key for plots are in Appendix B.

Table 24 (continued)

STORM NO.: 12 DATE: 2/12/79 RAINFALL(MM): 37.1 EI30(METRIC): 13.0

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	103.3	11.5	10.81	1.2402	3.3519	0	0
2	99.4	11.1	6.56	0.7282	2.8008	0	0
3	114.6	12.5	9.93	1.2378	3.9929	0	0
4	116.1	13.0	3.61	0.4684	1.4637	0	0
5	108.3	12.0	2.37	0.2846	0.9024	89	0
6	117.1	13.2	4.33	0.5708	2.3783	89	0
7	96.4	10.8	2.38	0.2540	0.9214	89	0
8	103.3	12.0	0.54	0.0642	0.1945	89	0
9	111.5	12.5	0.52	0.0646	0.1794	89	27
10	103.4	11.4	0.83	0.0954	0.3407	89	37
11	101.4	11.3	0.76	0.0856	0.2853	89	37
12	111.1	13.2	0.81	0.1079	0.3372	89	37
13	99.5	11.1	0.14	0.0153	0.0478	89	57
14	93.0	10.4	0.32	0.0336	0.1159	89	68
15	95.4	10.5	0.13	0.0136	0.0412	89	75
16	84.2	10.2	0.57	0.0570	0.1927	89	67
17	91.1	10.1	3.08	0.3104	1.1096	0	0
18	106.8	12.1	12.26	1.4845	4.4945	0	0
19	109.3	12.1	0.95	0.1151	0.3480	0	0
20	95.9	10.4	2.81	0.2924	1.2183	0	0
21	92.9	10.3	4.49	0.4646	1.6593	89	0
22	109.3	12.3	1.24	0.1530	0.5100	89	0
23	98.1	10.8	1.90	0.2053	0.6221	89	0
24	107.3	12.8	9.03	1.1601	4.4619	89	0
25	100.6	11.2	0.89	0.0997	0.3438	89	17
26	103.3	11.7	1.99	0.2329	0.8954	89	7
27	100.9	11.0	0.52	0.0563	0.2104	89	22
28	116.1	13.1	1.81	0.2371	0.9879	89	33
29	107.3	12.1	0.45	0.0550	0.1719	89	47
30	98.8	11.2	0.21	0.0239	0.0821	89	42
31	101.4	11.1	0.29	0.0319	0.1100	89	59
32	92.1	10.4	0.19	0.0202	0.0804	89	70
33	101.7	11.4	8.08	0.9238	3.2993	0	0
34	90.5	10.0	7.38	0.7413	2.2464	0	0
35	113.1	12.8	8.70	1.1161	4.6504	0	0
36	101.4	11.2	8.17	0.9140	2.9484	0	0
37	103.4	11.5	3.02	0.3463	1.1543	89	0
38	103.9	11.7	2.43	0.2841	0.7892	89	0
39	100.9	11.1	4.06	0.4531	1.8879	89	0
40	105.5	11.7	2.57	0.3018	0.8157	89	0
41	107.2	12.0	0.67	0.0802	0.2673	89	20
42	103.8	11.3	2.40	0.2720	0.9067	89	5
43	109.3	12.4	0.57	0.0715	0.2860	89	30
44	104.3	11.4	1.10	0.1253	0.3481	89	32
45	92.8	10.2	0.25	0.0256	0.0914	89	46
46	100.9	11.3	0.87	0.0984	0.2894	89	38
47	108.3	12.1	0.17	0.0202	0.0918	89	52
48	98.9	10.9	0.38	0.0414	0.1183	89	50

STORM NO.: 13 DATE: 2/20/79 RAINFALL(MM): 31.7 EI30(METRIC): 2.3

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	97.9	10.9	0.57	0.0624	0.1686	0	0
2	78.3	8.7	1.69	0.1473	0.5665	0	0
3	105.8	11.5	0.85	0.0990	0.3161	0	0
4	74.3	8.3	0.71	0.0592	0.1850	0	0
5	114.1	12.6	0.17	0.0211	0.0639	86	0
6	37.0	4.2	0.61	0.0254	0.1059	86	0
7	40.4	4.5	0.32	0.0147	0.0525	86	0
8	36.0	4.2	0.42	0.0174	0.0527	86	0
9	25.7	2.9	1.07	0.0309	0.0856	86	27
10	19.0	2.1	0.50	0.0105	0.0375	86	33
11	26.2	2.9	0.36	0.0106	0.0353	86	39
12	17.7	2.1	0.40	0.0083	0.0259	86	45
13	5.0	0.6	0.18	0.0010	0.0031	86	54
14	3.8	0.4	0.39	0.0017	0.0059	86	65
15	4.5	0.5	0.24	0.0012	0.0036	86	72
16	5.1	0.6	1.24	0.0077	0.0257	86	57
17	108.6	12.0	0.60	0.0724	0.2586	0	0
18	66.0	7.5	1.77	0.1323	0.4009	0	0
19	61.9	6.8	0.56	0.0386	0.1170	0	0
20	83.6	9.1	0.46	0.0421	0.1754	0	0
21	17.1	1.9	0.46	0.0087	0.0311	86	0
22	24.7	2.9	0.19	0.0054	0.0180	86	0
23	48.2	5.3	0.53	0.0280	0.0849	86	0
24	61.8	7.4	0.75	0.0556	0.2139	86	0
25	24.7	2.9	0.33	0.0091	0.0314	86	17
26	30.2	3.4	0.62	0.0212	0.0815	86	10
27	25.7	2.9	1.18	0.0328	0.1215	86	29
28	23.6	2.7	0.48	0.0129	0.0537	86	41
29	16.8	1.9	0.21	0.0041	0.0128	86	47
30	8.0	0.9	0.41	0.0037	0.0128	86	37
31	2.5	0.3	1.20	0.0033	0.0114	86	56
32	3.7	0.4	0.19	0.0008	0.0032	86	59
33	69.0	7.8	2.23	0.1730	0.6179	0	0
34	59.1	6.6	0.86	0.0565	0.1712	0	0
35	75.1	8.5	0.33	0.0243	0.1179	0	0
36	98.6	10.9	0.93	0.1004	0.3252	0	0
37	24.7	2.8	0.84	0.0232	0.0773	86	0
38	31.1	3.5	0.45	0.0159	0.0442	86	0
39	46.4	5.1	1.16	0.0593	0.2471	86	0
40	40.4	4.5	0.63	0.0282	0.0762	86	0
41	32.5	3.6	0.70	0.0251	0.0943	86	20
42	32.5	3.6	0.35	0.0129	0.0417	86	7
43	27.2	3.1	0.48	0.0149	0.0596	86	40
44	12.8	1.4	0.34	0.0047	0.0131	86	34
45	6.5	0.7	0.48	0.0034	0.0121	86	45
46	5.0	0.6	1.09	0.0061	0.0179	86	37
47	1.2	0.1	0.25	0.0003	0.0014	86	49
48	2.5	0.3	0.88	0.0024	0.0069	86	38

Key for plots are in Appendix B.

Table 24 (continued)

STORM NO.: 14 DATE: 2/21/79 RAINFALL(MM): 71.9 EI30(METRIC): 25.7

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	113.6	12.8	16.44	2.0757	5.6100	0	0
2	111.1	12.4	46.61	5.7796	22.2292	0	0
3	99.2	10.8	55.63	6.0049	19.3706	0	0
4	111.1	12.4	7.23	0.8977	2.8353	0	0
5	103.3	11.5	10.09	1.1559	3.5027	86	0
6	112.6	12.7	8.62	1.0919	4.5495	86	0
7	111.1	12.5	6.88	0.8597	3.0734	86	0
8	109.3	12.6	5.97	0.7556	2.2897	86	0
9	103.3	11.5	4.17	0.4809	1.3354	86	27
10	104.8	11.6	2.08	0.2415	0.8625	86	33
11	112.1	12.5	3.97	0.4948	1.6493	86	39
12	105.3	12.6	1.57	0.1964	0.6137	86	45
13	111.2	12.4	0.17	0.0206	0.0644	86	54
14	99.9	11.2	0.56	0.0619	0.2134	86	65
15	96.9	10.6	0.41	0.0434	0.1315	86	72
16	91.0	11.1	1.03	0.1136	0.3787	86	57
17	107.8	11.9	22.87	2.7242	9.7293	0	0
18	96.9	11.0	32.39	3.5584	10.7830	0	0
19	106.3	11.7	6.32	0.7070	2.1424	0	0
20	107.3	11.7	16.57	1.9333	8.0542	0	0
21	98.9	11.0	9.50	1.0463	3.7[illegible]8	86	0
22	108.3	12.2	2.40	0.2931	0.9770	86	0
23	90.3	10.0	4.29	0.4268	1.2933	86	0
24	111.1	13.3	13.98	1.8602	7.1546	86	0
25	111.1	12.4	2.49	0.3085	1.0638	86	17
26	99.9	11.3	10.57	1.1958	4.5992	86	10
27	105.8	11.5	2.33	0.2684	0.9941	86	29
28	107.8	12.2	5.13	0.6256	2.6067	86	41
29	108.6	12.3	0.76	0.0932	0.2913	86	47
30	108.0	12.2	0.92	0.1121	0.3866	86	37
31	105.2	11.5	0.95	0.1101	0.3797	86	56
32	107.9	12.2	0.24	0.0293	0.1172	86	59
33	112.4	12.6	26.65	3.3655	12.3196	0	0
34	112.6	12.5	38.51	4.8125	14.5833	0	0
35	104.9	11.9	24.44	2.9062	12.1092	0	0
36	100.4	11.1	22.55	2.4985	8.0597	0	0
37	103.3	11.5	3.85	0.4436	1.4787	86	0
38	110.1	12.4	7.68	0.9539	2.6497	86	0
39	111.3	12.3	39.12	4.8112	20.0467	86	0
40	103.3	11.5	11.08	1.2721	3.4381	86	0
41	103.9	11.6	2.90	0.3376	1.1253	86	20
42	119.0	13.0	4.16	0.5407	1.3023	86	7
43	119.0	13.6	3.91	0.5296	2.1184	86	40
44	106.9	11.6	3.60	0.4195	1.1653	86	34
45	98.4	10.9	0.83	0.0905	0.3232	86	45
46	95.4	10.7	2.40	0.2565	0.7544	86	37
47	95.4	10.7	0.55	0.0584	0.2655	86	48
48	106.3	11.7	0.42	0.0488	0.1394	86	38

STORM NO.: 15 DATE: 2/22/79 RAINFALL(MM): 14.0 EI30(METRIC): 1.6

PLOT	RUNOFF (LITER)	RUNOFF (MM)	CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	79.6	8.8	4.43	0.3922	1.0600	0	0
2	63.6	7.1	1.73	0.1229	0.4727	0	0
3	69.0	7.5	7.70	0.5785	1.8661	0	0
4	59.1	6.6	3.35	0.2213	0.6916	0	0
5	42.4	4.7	1.72	0.0809	0.2452	86	0
6	50.5	5.7	3.04	0.1726	0.7192	86	0
7	43.4	4.9	1.51	0.0737	0.2632	86	0
8	44.4	5.1	0.73	0.0376	0.1139	86	0
9	58.1	6.5	0.44	0.0288	0.0803	86	27
10	40.4	4.5	0.86	0.0385	0.1375	86	33
11	61.1	6.9	1.46	0.0993	0.3310	86	39
12	35.0	4.2	0.55	0.0228	0.0712	86	45
13	69.0	7.7	0.14	0.0107	0.0334	86	54
14	27.2	3.0	0.20	0.0061	0.0210	86	65
15	22.3	2.5	0.18	0.0045	0.0136	86	72
16	20.8	2.5	0.56	0.0147	0.0490	86	57
17	64.0	7.1	4.32	0.3057	1.0918	0	0
18	67.5	7.7	4.96	0.3798	1.1509	0	0
19	64.0	7.1	1.72	0.1218	0.3691	0	0
20	79.7	8.7	2.56	0.2222	0.9259	0	0
21	56.1	6.2	2.63	0.1643	0.5864	86	0
22	48.2	5.4	2.20	0.1199	0.3997	86	0
23	36.5	4.2	1.55	0.0656	0.1049	86	0
24	81.6	9.8	2.24	0.2189	0.8419	86	0
25	56.1	6.3	0.52	0.0324	0.1117	86	17
26	40.4	4.6	0.70	0.0322	0.1239	86	10
27	61.6	6.7	0.62	0.0415	0.1537	86	29
28	32.5	3.7	1.05	0.0385	0.1634	86	41
29	35.5	4.0	0.32	0.0130	0.0406	86	47
30	27.2	3.1	0.33	0.0103	0.0355	86	37
31	19.8	2.2	0.33	0.0072	0.0249	86	56
32	25.7	2.9	0.23	0.0067	0.0264	86	59
33	49.7	5.6	6.23	0.3480	1.2429	0	0
34	50.2	5.6	4.04	0.2250	0.6819	0	0
35	57.1	6.5	6.62	0.4286	1.7858	0	0
36	64.5	7.1	5.43	0.3463	1.2441	0	0
37	45.9	5.1	3.13	0.1602	0.5343	86	0
38	35.5	4.0	1.43	0.0574	0.1594	86	0
39	40.4	4.5	1.86	0.0831	0.3463	86	0
40	57.1	6.3	1.11	0.0704	0.1933	86	0
41	37.5	4.2	0.59	0.0244	0.0833	86	20
42	51.3	5.6	1.78	0.0997	0.3323	86	7
43	41.4	4.7	0.72	0.0341	0.1364	86	40
44	46.4	5.1	1.94	0.0979	0.2719	86	34
45	32.5	3.6	0.29	0.0103	0.0374	86	45
46	29.7	3.3	0.43	0.0142	0.0418	86	37
47	33.5	3.8	0.33	0.0126	0.0573	86	48
48	24.7	2.7	0.25	0.0068	0.0194	86	38

Key for plots are in Appendix B.

Table 24 (continued)

STORM NO.: 16 DATE: 2/26/79 RAINFALL(MM): 2.3 EI30(METRIC): 0.2

PLOT	RUNOFF (LITER)	RUNOFF (MM)	SOIL LOSS CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	4.9	0.5	0.0	0.0	0.0	0	0
2	5.0	0.6	0.0	0.0	0.0	0	0
3	4.2	0.5	0.0	0.0	0.0	0	0
4	4.0	0.4	0.0	0.0	0.0	0	0
5	8.4	0.9	0.0	0.0	0.0	85	0
6	0.7	0.1	0.0	0.0	0.0	85	0
7	2.0	0.2	0.0	0.0	0.0	85	0
8	0.3	0.0	0.0	0.0	0.0	85	0
9	1.1	0.1	0.0	0.0	0.0	85	27
10	0.4	0.0	0.0	0.0	0.0	85	34
11	1.3	0.1	0.0	0.0	0.0	85	40
12	0.6	0.1	0.0	0.0	0.0	85	47
13	0.2	0.0	0.0	0.0	0.0	85	53
14	0.3	0.0	0.0	0.0	0.0	85	64
15	0.0	0.0	0.0	0.0	0.0	85	71
16	0.0	0.0	0.0	0.0	0.0	85	55
17	4.8	0.5	0.0	0.0	0.0	0	0
18	3.3	0.4	0.0	0.0	0.0	0	0
19	1.5	0.2	0.0	0.0	0.0	0	0
20	4.2	0.5	0.0	0.0	0.0	0	0
21	2.5	0.3	0.0	0.0	0.0	85	0
22	0.7	0.1	0.0	0.0	0.0	85	0
23	0.5	0.1	0.0	0.0	0.0	85	0
24	1.2	0.1	0.0	0.0	0.0	85	0
25	0.9	0.1	0.0	0.0	0.0	85	17
26	2.0	0.2	0.0	0.0	0.0	85	10
27	0.7	0.1	0.0	0.0	0.0	85	31
28	0.5	0.1	0.0	0.0	0.0	85	45
29	0.7	0.1	0.0	0.0	0.0	85	47
30	0.3	0.0	0.0	0.0	0.0	85	36
31	0.1	0.0	0.0	0.0	0.0	85	56
32	0.1	0.0	0.0	0.0	0.0	85	58
33	3.7	0.4	0.0	0.0	0.0	0	0
34	4.8	0.5	0.0	0.0	0.0	0	0
35	5.0	0.6	0.0	0.0	0.0	0	0
36	4.5	0.5	0.0	0.0	0.0	0	0
37	1.6	0.2	0.0	0.0	0.0	85	0
38	1.5	0.2	0.0	0.0	0.0	85	0
39	0.9	0.1	0.0	0.0	0.0	85	0
40	1.5	0.2	0.0	0.0	0.0	85	0
41	1.5	0.2	0.0	0.0	0.0	85	20
42	1.5	0.2	0.0	0.0	0.0	85	9
43	0.3	0.0	0.0	0.0	0.0	85	41
44	0.2	0.0	0.0	0.0	0.0	85	35
45	0.5	0.1	0.0	0.0	0.0	85	45
46	0.2	0.0	0.0	0.0	0.0	85	37
47	0.6	0.1	0.0	0.0	0.0	85	48
48	0.1	0.0	0.0	0.0	0.0	85	38

STORM NO.: 17 DATE: 10/ 9/79 RAINFALL(MM): 10.4 EI30(METRIC): 0.0

PLOT	RUNOFF (LITER)	RUNOFF (MM)	SOIL LOSS CONC (G/L)	SOIL LOSS TOTAL (T/HA)	SOIL LOSS ADJUSTED (T/HA/SL)	VEGETATIVE COVER CORN (%)	VEGETATIVE COVER LEGUME (%)
1	2.5	0.3	0.0	0.0	0.0	0	0
2	6.5	0.7	0.0	0.0	0.0	0	0
3	6.0	0.7	0.0	0.0	0.0	0	0
4	5.2	0.6	0.0	0.0	0.0	0	0
5	0.2	0.0	0.0	0.0	0.0	86	0
6	2.0	0.2	0.0	0.0	0.0	86	0
7	2.0	0.2	0.0	0.0	0.0	86	0
8	1.3	0.1	0.0	0.0	0.0	86	0
9	2.0	0.2	0.0	0.0	0.0	86	35
10	1.5	0.2	0.0	0.0	0.0	86	38
11	2.8	0.3	0.0	0.0	0.0	86	42
12	1.8	0.2	0.0	0.0	0.0	86	24
13	2.0	0.2	0.0	0.0	0.0	86	48
14	1.5	0.2	0.0	0.0	0.0	86	33
15	2.0	0.2	0.0	0.0	0.0	86	26
16	2.5	0.3	0.0	0.0	0.0	86	35
17	2.5	0.3	0.0	0.0	0.0	0	0
18	7.0	0.8	0.0	0.0	0.0	0	0
19	2.5	0.3	0.0	0.0	0.0	0	0
20	4.2	0.5	0.0	0.0	0.0	0	0
21	2.2	0.2	0.0	0.0	0.0	86	0
22	2.2	0.2	0.0	0.0	0.0	86	0
23	0.5	0.1	0.0	0.0	0.0	86	0
24	3.5	0.4	0.0	0.0	0.0	86	0
25	0.5	0.1	0.0	0.0	0.0	86	12
26	6.0	0.7	0.0	0.0	0.0	86	32
27	0.2	0.0	0.0	0.0	0.0	86	22
28	2.5	0.3	0.0	0.0	0.0	86	32
29	1.0	0.1	0.0	0.0	0.0	86	43
30	1.2	0.1	0.0	0.0	0.0	86	24
31	1.2	0.1	0.0	0.0	0.0	86	20
32	3.8	0.4	0.0	0.0	0.0	86	19
33	1.8	0.2	0.0	0.0	0.0	0	0
34	6.5	0.7	0.0	0.0	0.0	0	0
35	4.0	0.5	0.0	0.0	0.0	0	0
36	4.0	0.4	0.0	0.0	0.0	0	0
37	0.8	0.1	0.0	0.0	0.0	86	0
38	1.5	0.2	0.0	0.0	0.0	86	0
39	2.0	0.2	0.0	0.0	0.0	86	0
40	2.5	0.3	0.0	0.0	0.0	86	0
41	1.2	0.1	0.0	0.0	0.0	86	13
42	2.2	0.2	0.0	0.0	0.0	86	20
43	1.5	0.2	0.0	0.0	0.0	86	12
44	2.0	0.2	0.0	0.0	0.0	86	20
45	1.5	0.2	0.0	0.0	0.0	86	30
46	1.5	0.2	0.0	0.0	0.0	86	46
47	0.5	0.1	0.0	0.0	0.0	86	24
48	2.0	0.2	0.0	0.0	0.0	86	8

Key for plots are in Appendix B .

APPENDIX C

Table 25. Cumulative Soil Loss and Runoff for the Cover Treatments

Cumulative Soil Loss (t/ha) for the Cover Treatments					Cumulative Runoff (mm) for the Cover Treatments				
Day	Fallow	Maize	'Kalo'	Rose Clover	Day	Fallow	Maize	'Kalo'	Rose Clover
2	0.083	0.129	0.049	0.048	2	0.578	0.213	0.172	0.172
3	0.656	0.558	0.481	0.401	3	3.147	2.312	2.057	1.942
4	0.703	0.602	0.550	0.434	4	3.288	2.461	2.183	2.091
5	7.301	6.300	8.875	9.300	5	14.357	13.478	13.674	13.127
39	7.886	6.650	9.141	9.394	39	16.536	14.760	14.614	13.718
40	7.887	6.651	9.142	9.395	40	16.598	14.819	14.660	13.770
41	8.583	7.099	9.597	9.617	41	28.803	26.420	26.122	25.264
44	8.586	7.100	9.598	9.618	44	29.170	26.544	26.254	25.384
45	8.587	7.101	9.598	9.618	45	29.196	26.565	26.270	25.405
51	9.574	7.353	9.882	9.683	51	34.836	29.624	28.562	26.048
66	9.944	7.594	10.112	9.788	66	47.087	41.442	40.156	33.969
72	14.653	10.044	10.990	10.086	72	58.595	53.145	52.039	44.932
80	15.223	10.239	11.110	10.108	80	67.641	58.045	54.815	45.538
81	33.756	18.173	14.093	10.701	81	79.527	70.000	66.930	56.986
82	35.635	18.884	14.425	10.788	82	86.632	75.503	72.155	60.422
86	35.639	18.886	14.425	10.788	86	87.094	75.709	72.257	60.450
305	35.643	18.887	14.427	10.790	305	87.582	75.904	72.483	60.644

APPENDIX D

APPENDIX D

Table 26. Cumulative Soil Loss (t/ha) for Individual Plots

PLOT	STORM NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	0.025	0.417	0.424	4.774	5.760	5.760	6.207	6.207	6.207	6.777	6.958	12.774	13.067	22.801	24.640	24.640	24.640
2	0.046	0.440	0.483	12.218	12.537	12.537	13.063	13.063	13.063	13.777	14.071	18.930	19.913	58.481	59.301	59.301	59.301
3	0.032	0.610	0.719	7.916	8.306	8.306	9.877	9.877	9.877	10.754	11.116	18.042	18.591	52.200	55.438	55.438	55.438
4	0.152	0.571	0.603	9.275	9.631	9.631	10.432	10.432	10.432	11.256	11.540	14.080	14.401	19.266	20.466	20.466	20.466
5	0.037	0.316	0.341	2.363	2.471	2.471	3.089	3.089	3.089	3.230	3.311	4.808	4.918	10.995	11.421	11.421	11.421
6	0.016	0.331	0.342	6.928	7.158	7.158	7.203	7.203	7.203	7.341	7.464	11.591	11.775	19.669	20.917	20.917	20.917
7	0.172	0.238	0.242	2.480	2.732	2.732	3.094	3.094	3.094	3.458	3.600	5.198	5.289	10.618	11.074	11.074	11.074
8	0.304	0.701	0.995	20.457	20.737	20.737	20.911	20.911	20.911	21.089	21.260	21.593	21.689	25.663	25.861	25.861	25.861
9	0.051	0.552	0.568	5.055	5.163	5.163	5.723	5.723	5.723	5.879	5.938	6.250	6.399	8.715	8.854	8.854	8.854
10	0.012	0.196	0.205	6.288	6.752	6.752	7.458	7.458	7.458	7.667	7.835	8.426	8.491	9.988	10.226	10.226	10.226
11	0.129	0.253	0.303	4.105	4.331	4.331	4.512	4.512	4.512	4.718	4.787	5.282	5.343	8.203	8.777	8.777	8.777
12	0.036	0.529	0.549	34.398	34.505	34.505	34.579	34.579	34.579	34.698	34.810	35.395	35.440	36.505	36.628	36.628	36.628
13	0.036	0.427	0.476	3.654	3.807	3.807	3.936	3.936	3.936	3.966	3.977	4.060	4.066	4.177	4.235	4.235	4.235
14	0.015	0.081	0.092	5.043	5.148	5.148	5.169	5.169	5.169	5.212	5.232	5.433	5.443	5.813	5.850	5.850	5.850
15	0.057	0.149	0.161	2.552	2.583	2.583	2.761	2.761	2.761	2.781	2.794	2.867	2.873	3.100	3.123	3.123	3.123
16	0.068	0.240	0.332	15.658	15.743	15.743	15.855	15.855	15.855	15.920	15.950	16.284	16.329	16.984	17.068	17.068	17.068
17	0.067	0.408	0.421	5.757	6.196	6.196	6.794	6.794	6.794	7.373	7.751	9.674	10.123	27.303	28.897	28.897	28.897
18	0.101	0.166	0.182	2.451	2.602	2.602	2.909	2.909	2.909	3.176	3.373	11.178	11.874	30.581	32.578	32.578	32.578
19	0.023	0.039	0.043	2.768	2.976	2.976	3.011	3.011	3.011	3.293	3.431	4.036	4.239	7.954	8.594	8.594	8.594
20	0.168	1.110	1.318	3.962	4.432	4.432	5.022	5.022	5.022	6.145	6.266	8.379	8.633	22.658	24.264	24.264	24.264
21	0.086	0.720	0.756	4.161	4.505	4.505	4.850	4.850	4.850	5.045	5.192	8.071	8.125	14.607	15.625	15.625	15.625
22	0.136	0.393	0.465	8.858	8.928	8.928	9.165	9.165	9.165	9.352	9.455	10.340	10.371	12.068	12.762	12.762	12.762
23	0.137	0.164	0.166	7.078	8.399	8.399	8.604	8.604	8.604	8.783	8.895	9.974	10.121	12.367	12.711	12.711	12.711
24	0.110	0.425	0.473	6.870	7.248	7.248	7.831	7.831	7.831	8.199	8.601	16.343	16.714	29.126	30.586	30.586	30.586
25	0.011	0.812	0.824	2.806	3.109	3.109	3.382	3.382	3.382	3.498	3.578	4.171	4.229	6.073	6.267	6.267	6.267
26	0.043	0.231	0.240	22.725	22.917	22.917	23.017	23.017	23.017	23.281	23.505	25.059	25.203	33.179	33.393	33.393	33.393
27	0.010	0.064	0.064	6.010	6.121	6.121	6.251	6.251	6.251	6.468	6.583	6.949	7.160	8.884	9.151	9.151	9.151
28	0.091	0.757	0.997	2.907	3.344	3.344	3.677	3.677	3.677	4.343	4.652	6.365	6.458	10.980	11.258	11.258	11.258
29	0.061	1.106	1.154	3.917	4.058	4.058	4.114	4.114	4.114	4.209	4.275	4.573	4.595	5.099	5.169	5.169	5.169
30	0.054	0.240	0.246	17.036	17.094	17.094	17.328	17.328	17.328	17.395	17.438	17.580	17.602	18.275	18.337	18.337	18.337
31	0.025	0.077	0.083	17.746	17.788	17.788	17.984	17.984	17.984	18.013	18.051	18.242	18.262	18.921	18.964	18.964	18.964
32	0.133	0.987	1.091	4.933	5.009	5.009	5.049	5.049	5.049	5.083	5.104	5.244	5.249	5.454	5.500	5.500	5.500
33	0.082	1.339	1.399	19.494	19.811	19.811	20.298	20.298	20.298	21.810	22.126	27.820	28.892	49.746	51.903	51.903	51.903
34	0.063	0.413	0.435	3.914	4.716	4.716	5.046	5.046	5.046	5.923	6.133	10.029	10.326	35.627	36.810	36.810	36.810
35	0.110	1.039	1.078	8.299	8.963	8.963	10.016	10.016	10.016	11.122	11.562	19.631	19.836	40.846	43.945	43.945	43.945
36	0.073	1.002	1.013	5.354	7.050	7.050	7.443	7.443	7.443	9.996	10.294	15.410	15.974	29.958	32.120	32.120	32.120
37	0.115	0.617	0.634	5.371	5.691	5.691	6.271	6.271	6.271	6.576	6.682	8.703	8.837	11.403	12.329	12.329	12.329
38	0.038	0.315	0.334	1.540	1.657	1.657	1.909	1.909	1.909	2.245	2.333	3.702	3.778	8.376	8.653	8.653	8.653
39	0.316	1.229	1.248	3.489	3.681	3.681	3.928	3.928	3.928	4.094	4.199	7.475	7.904	42.685	43.286	43.286	43.286
40	0.084	0.962	0.982	4.656	5.118	5.118	5.696	5.696	5.696	5.866	5.991	7.406	7.539	13.504	13.834	13.834	13.834
41	0.057	0.725	1.025	7.614	8.064	8.064	8.353	8.353	8.353	8.478	8.578	9.041	9.188	11.139	11.283	11.283	11.283
42	0.045	0.317	0.394	3.891	4.029	4.029	4.502	4.502	4.502	4.613	4.773	6.347	6.419	9.546	10.123	10.123	10.123
43	0.053	0.568	0.568	3.854	4.064	4.064	4.101	4.101	4.101	4.429	4.495	4.992	5.095	8.771	9.007	9.007	9.007
44	0.041	0.553	0.650	5.476	5.837	5.837	6.996	6.996	6.996	7.637	7.792	8.395	8.417	10.440	10.912	10.912	10.912
45	0.028	0.385	0.440	28.171	28.312	28.312	28.426	28.426	28.426	28.555	28.629	28.787	28.808	29.369	29.433	29.433	29.433
46	0.096	0.114	0.122	1.961	2.041	2.041	2.248	2.248	2.248	2.282	2.321	2.822	2.853	4.163	4.235	4.235	4.235
47	0.029	0.235	0.247	2.222	2.335	2.335	2.426	2.426	2.426	2.497	2.565	2.723	2.726	3.184	3.284	3.284	3.284
48	0.073	0.581	0.646	7.396	7.441	7.441	7.584	7.584	7.584	7.676	7.720	7.926	7.938	8.179	8.212	8.212	8.212

APPENDIX D

Table 27. Cumulative Soil Loss (t/ha) Fallow

	NITROGEN FERTILIZER RATE (KG/HA)		
DAY	190	380	570
2	0.064	0.090	0.082
3	0.509	0.431	0.951
4	0.557	0.490	0.981
5	8.546	3.735	9.263
39	9.059	4.051	10.135
40	9.059	4.051	10.135
41	9.895	4.434	10.701
44	9.895	4.434	10.701
45	9.895	4.434	10.701
51	10.641	4.997	12.213
66	10.921	5.205	12.529
72	15.956	8.317	18.223
80	16.4[illegible]	8.729	18.757
81	38.187	22.049	39.045
82	39.961	23.583	41.194
86	39.961	23.583	41.194
305	39.961	23.583	41.194

Table 28. Cumulative Soil Loss (t/ha) Maize

	NITROGEN FERTILIZER RATE (KG/HA)		
DAY	190	380	570
2	0.132	0.110	0.139
3	0.412	0.426	0.780
4	0.480	0.465	0.799
5	8.057	6.741	3.764
39	8.274	7.270	4.037
40	8.274	7.270	4.037
41	8.574	7.612	4.451
44	8.574	7.612	4.451
45	8.574	7.612	4.451
51	8.779	7.845	4.695
66	8.909	8.036	4.801
72	10.799	11.182	6.821
80	10.918	11.333	7.014
81	16.736	17.042	18.992
82	17.318	17.921	19.525
86	17.318	17.921	19.525
305	17.318	17.921	19.525

APPENDIX D

Table 29. Cumulative Soil Loss (t/ha)
Rose Clover

	NITROGEN FERTILIZER RATE (KG/HA)		
DAY	190	380	570
2	0.044	0.061	0.034
3	0.224	0.603	0.329
4	0.265	0.621	0.365
5	6.727	10.908	9.937
39	6.820	10.987	10.032
40	6.820	10.987	10.032
41	6.930	11.119	10.171
44	6.930	11.119	10.171
45	6.930	11.119	10.171
51	6.970	11.175	10.253
66	6.988	11.217	10.309
72	7.161	11.410	10.564
80	7.178	11.427	10.581
81	7.518	11.937	11.224
82	7.569	11.993	11.291
86	7.569	11.993	11.291
305	7.569	11.993	11.291

Table 30. Cumulative Soil Loss (t/ha)
'Kalo'

	NITROGEN FERTILIZER RATE (KG/HA)		
DAY	190	380	570
2	0.057	0.036	0.049
3	0.386	0.466	0.540
4	0.406	0.531	0.659
5	12.461	8.612	5.209
39	12.688	8.873	5.499
40	12.688	8.873	5.499
41	13.068	9.082	5.988
44	13.068	9.082	5.968
45	13.068	9.082	5.988
51	13.240	9.403	6.289
66	13.343	9.580	6.410
72	13.838	10.637	7.194
80	13.918	10.762	7.280
81	15.853	14.779	9.974
82	16.121	15.017	10.331
86	16.121	15.017	10.331
305	16.121	15.017	10.331

APPENDIX D

Table 31. Cumulative Runoff (mm) for Individual Plots

PLOT	STORM NO. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	2.677	5.255	5.321	16.786	20.730	20.740	32.495	32.771	32.781	38.826	50.860	62.338	73.216	85.837	94.681	95.224	95.500
2	1.953	3.827	3.984	15.289	16.282	16.360	28.704	28.881	28.914	32.830	45.230	56.324	65.061	77.461	84.560	85.118	85.844
3	0.218	2.209	2.384	14.017	15.845	15.944	28.478	29.097	29.140	36.277	47.549	60.017	71.528	82.323	89.831	90.283	90.940
4	0.289	2.143	2.320	14.568	17.125	17.203	30.240	30.753	30.763	36.091	48.816	61.787	70.087	82.499	89.102	89.549	90.130
5	0.187	1.710	1.842	12.019	12.516	12.538	24.765	24.853	24.875	26.449	39.209	51.215	63.864	75.316	80.017	80.949	80.971
6	0.190	2.148	2.295	14.004	15.230	15.303	28.625	28.805	28.838	30.087	42.695	55.867	60.030	72.696	78.375	78.453	78.679
7	0.130	1.000	1.157	10.953	11.953	12.021	22.661	22.795	22.817	26.258	37.606	48.449	52.993	65.489	70.370	70.596	70.822
8	0.243	2.048	2.268	13.875	15.586	15.677	26.830	27.088	27.123	30.384	42.573	54.528	58.693	71.342	76.480	76.515	76.664
9	0.200	1.853	1.997	13.528	14.366	14.432	25.917	26.117	26.117	28.776	41.257	53.715	56.587	68.128	74.620	74.741	74.964
10	0.088	1.370	1.413	13.770	14.943	14.965	25.970	26.046	26.056	27.295	39.718	51.155	53.255	64.847	69.314	69.357	69.522
11	0.210	1.210	1.377	13.576	14.492	14.560	27.872	28.039	28.072	29.938	41.637	52.904	55.814	68.270	75.059	75.203	75.512
12	0.251	1.561	1.687	12.294	12.947	13.063	25.427	25.653	25.689	29.189	39.022	52.263	54.373	66.923	71.093	71.164	71.377
13	0.167	1.556	1.710	11.598	12.243	12.369	22.598	22.775	22.908	23.430	30.874	41.930	42.486	54.840	62.505	62.527	62.747
14	0.177	0.778	0.912	11.046	11.414	11.469	23.109	23.266	23.299	23.667	27.728	38.136	38.530	49.680	52.715	52.748	52.915
15	0.220	1.065	1.263	11.240	11.871	11.897	22.907	23.061	23.094	23.622	30.820	41.302	41.797	52.444	54.895	54.895	55.115
16	0.218	1.199	1.385	12.769	13.449	13.522	24.652	24.847	24.832	25.318	29.765	39.996	40.615	51.671	54.198	54.198	54.502
17	0.220	1.954	2.119	14.041	16.141	16.217	27.837	28.337	28.370	33.973	49.200	59.266	71.287	83.199	90.270	90.800	91.076
18	0.226	1.054	1.234	12.605	13.953	14.031	26.921	27.317	27.339	32.101	44.120	56.228	63.710	74.695	82.348	82.721	83.513
19	0.055	0.409	0.418	4.606	6.063	6.196	18.635	18.944	18.960	22.854	35.129	47.206	54.033	65.777	72.848	73.013	73.289
20	0.172	4.192	4.387	16.733	18.678	18.731	30.285	30.566	30.599	37.087	49.446	59.870	68.958	80.621	89.264	89.741	90.198
21	0.256	2.894	3.034	14.318	15.798	15.864	24.873	24.994	25.004	28.646	39.692	50.037	51.941	62.954	69.202	69.481	69.724
22	0.203	1.127	1.261	10.877	11.496	11.541	22.579	22.690	22.690	24.949	36.052	48.338	51.176	63.398	68.838	68.916	69.164
23	0.076	0.429	0.462	8.498	9.336	9.346	21.144	21.166	21.176	23.436	34.482	45.297	50.010	60.566	64.819	64.898	64.953
24	0.177	1.472	1.604	14.992	17.377	17.448	28.692	28.763	28.775	32.943	45.086	57.935	65.336	78.640	88.411	88.555	88.974
25	0.038	2.495	2.550	13.944	14.980	15.002	25.057	25.102	25.112	27.842	39.703	50.917	53.670	66.055	72.308	72.409	72.464
26	0.203	1.346	1.503	12.976	13.768	13.913	25.420	25.567	25.577	28.498	39.867	51.506	54.987	66.300	70.874	71.100	71.780
27	0.053	0.553	0.563	6.214	6.747	6.757	17.290	17.333	17.343	19.298	29.666	40.633	43.427	54.928	61.623	61.699	61.721
28	0.170	3.720	3.877	16.513	17.394	17.394	27.711	27.779	27.779	30.042	42.609	55.743	58.412	70.696	74.281	74.336	74.617
29	0.177	3.646	3.839	15.500	16.676	16.731	27.815	27.972	27.994	29.203	41.552	53.675	55.572	67.842	71.852	71.930	72.041
30	0.203	1.323	1.493	12.965	13.476	13.521	25.525	25.626	25.635	26.279	34.072	45.260	46.166	58.396	61.477	61.510	61.647
31	0.121	0.712	0.821	10.064	10.348	10.370	21.073	21.116	21.126	21.410	27.732	38.862	39.136	50.682	52.856	52.866	52.998
32	0.213	5.940	6.097	18.690	19.479	19.557	31.891	32.015	32.048	32.477	42.083	52.466	52.882	65.046	67.944	67.954	68.383
33	0.279	3.931	4.121	14.120	15.367	16.400	29.422	29.645	29.667	35.796	47.472	58.825	66.577	79.205	64.790	65.206	85.409
34	0.233	1.863	2.050	13.182	14.736	14.924	25.740	26.101	26.144	31.671	42.438	52.481	59.039	71.535	77.107	77.640	78.361
35	0.238	4.365	4.545	17.209	19.329	19.430	31.616	31.877	31.922	37.908	49.904	62.725	71.239	93.131	89.605	90.171	90.625
36	0.386	6.565	6.575	19.112	23.183	23.193	35.288	35.732	35.762	42.627	54.890	66.081	76.964	88.046	95.165	95.662	96.103
37	0.424	3.265	3.433	13.554	15.260	15.326	26.969	27.123	27.145	32.026	44.040	55.571	58.324	69.849	74.958	75.135	75.223
38	0.190	2.770	2.940	14.640	16.005	16.073	27.967	28.124	28.146	31.447	43.217	54.931	58.436	70.848	74.851	75.021	75.191
39	0.177	3.580	3.757	15.989	17.337	17.413	30.694	30.859	30.902	33.223	44.637	55.785	60.913	73.211	77.676	77.775	77.995
40	0.256	5.310	5.477	17.778	19.233	19.276	31.198	31.286	31.276	35.151	48.018	59.740	64.228	75.706	82.050	82.217	82.493
41	0.200	1.315	2.005	14.740	15.761	15.839	26.781	26.971	26.993	30.198	42.283	54.299	57.941	69.589	73.792	73.959	74.093
42	0.228	1.769	1.964	14.478	15.242	15.308	26.148	26.323	26.345	28.641	40.312	51.655	55.205	68.209	73.814	73.979	74.220
43	0.170	4.178	4.315	17.037	18.573	18.641	32.354	32.536	32.558	34.722	46.624	59.072	62.170	75.723	80.437	80.470	80.640
44	0.208	2.814	2.956	15.028	16.117	16.150	27.524	27.590	27.600	29.311	39.178	50.552	51.948	63.593	68.652	68.674	68.892
45	0.220	1.777	1.964	13.244	14.127	14.182	26.356	26.465	26.487	28.341	38.450	48.693	49.409	60.270	63.856	63.911	64.076
46	0.088	1.713	1.791	13.035	13.360	13.370	25.587	25.611	25.611	25.981	34.500	45.810	46.371	57.066	60.395	60.417	60.564
47	0.088	1.657	1.712	13.169	13.628	13.673	25.163	25.274	25.296	25.844	35.988	48.129	48.263	58.958	62.714	62.780	62.835
48	0.175	1.958	2.112	14.204	14.600	14.643	26.492	26.580	26.590	27.019	34.067	44.958	45.232	56.938	59.658	59.668	59.888

APPENDIX D

Table 32. Cumulative Runoff (mm)
Maize

	NITROGEN FERTILIZER RATE (KG/HA)		
DAY	190	380	570
2	0.200	0.178	0.262
3	1.726	1.478	3.731
4	1.890	1.591	3.902
5	12.713	12.169	15.553
39	13.821	13.502	16.959
40	13.886	13.550	17.022
41	25.733	24.322	29.207
44	25.885	24.401	29.348
45	25.913	24.411	29.372
51	28.419	27.493	32.962
66	40.521	38.828	44.978
72	52.515	50.414	56.507
80	58.895	54.766	60.475
81	71.211	66.389	72.401
82	76.310	72.815	77.384
86	76.628	72.962	77.537
305	76.784	73.204	77.725

Table 33. Cumulative Runoff (mm)
Fallow

	NITROGEN FERTILIZER RATE (KG/HA)		
DAY	190	380	570
2	1.284	0.168	0.284
3	3.358	1.902	4.181
4	3.502	2.039	4.323
5	15.170	11.996	15.906
39	17.495	13.709	18.404
40	17.562	13.771	18.462
41	29.979	25.912	30.518
44	30.375	26.291	30.844
45	30.399	26.316	30.874
51	36.006	31.504	37.001
66	48.114	44.474	48.676
72	60.117	55.642	60.028
80	69.973	64.497	68.455
81	82.030	76.073	80.479
82	89.543	83.688	86.667
86	90.045	84.069	87.170
305	90.603	84.519	87.624

APPENDIX D

Table 34. Cumulative Runoff (mm)
Rose Clover

	NITROGEN FERTILIZER RATE (KG/HA)		
DAY	190	380	570
2	0.195	0.178	0.143
3	1.147	2.905	1.776
4	1.317	3.062	1.895
5	11.663	14.305	13.413
39	12.232	14.995	13.929
40	12.299	15.045	13.967
41	23.316	26.576	25.900
44	23.487	26.682	25.982
45	23.521	26.701	25.996
51	24.009	27.340	26.796
66	29.797	36.360	35.751
72	40.333	47.566	46.897
80	40.857	48.439	47.319
81	52.159	60.492	58.308
82	56.078	63.532	61.656
86	56.092	63.565	61.694
305	56.320	63.767	61.846

Table 35. Cumulative Runoff (mm)
'Kalo'

	NITROGEN FERTILIZER RATE (KG/HA)		
DAY	190	380	570
2	0.187	0.128	0.201
3	1.498	2.028	2.644
4	1.618	2.123	2.810
5	13.292	12.412	15.321
39	14.197	13.222	16.423
40	14.256	13.241	16.484
41	26.296	23.869	28.202
44	26.464	23.945	28.355
45	26.483	23.953	28.374
51	28.549	26.420	30.718
66	40.408	37.961	42.099
72	52.509	49.715	53.895
80	55.007	52.624	56.816
81	67.042	64.472	69.279
82	72.521	69.771	74.174
86	72.616	69.886	74.270
305	72.844	70.145	74.461

APPENDIX E

APPENDIX E

Table 36. Rainfall Data and Erosivity Components From December 1978 to November 1979

DATE	TIME	DURATION (HR)	RAIN (IN)	MAX. RAIN INTENSITY (IN/HR) 5	10	15	30	60	ENERGY (FT-T/A)	EROSION INDICES EI05	EI10	EI15	EI30	EI60
12/ 3/78	2230	1.00	0.25	1.32	1.26	0.84	0.44	0.25	225.8	3.0	2.8	2.0	1.0	0.6
12/ 4/78	120	0.33	0.10	0.72	0.42	0.16	0.0	0.0	78.6	0.6	0.3	0.1	0.0	0.0
12/ 4/78	1620	6.50	0.65	1.20	1.08	0.72	0.36	0.24	509.4	6.1	5.5	3.7	1.8	1.2
12/ 5/78	215	3.83	0.40	0.49	0.30	0.20	0.18	0.15	274.6	1.3	1.0	0.5	0.5	0.4
12/ 5/78	1540	1.08	0.03	0.12	0.06	0.04	0.04	0.03	19.3	0.0	0.0	0.0	0.0	0.0
12/ 5/78	1955	1.33	0.05	0.12	0.06	0.03	0.06	0.04	33.6	0.0	0.0	0.0	0.0	0.0
12/ 5/78	2350	6.50	0.21	0.60	0.30	0.20	0.12	0.07	139.9	0.8	0.4	0.3	0.2	0.1
12/ 6/78	1155	5.50	1.09	1.44	1.44	1.32	1.12	0.80	914.8	13.2	13.2	12.1	10.3	7.4
12/20/78	845	0.58	0.05	0.36	0.12	0.03	0.04	0.0	37.3	0.1	0.0	0.0	0.0	0.0
12/23/78	2145	0.17	0.03	0.24	0.18	0.0	0.0	0.0	20.3	0.0	0.0	0.0	0.0	0.0
1/ 9/79	2110	9.50	0.91	0.94	0.72	0.52	0.26	0.18	630.8	5.3	4.5	3.3	1.6	1.1
1/10/79	1930	1.50	0.07	0.24	0.18	0.12	0.08	0.03	44.8	0.1	0.1	0.1	0.0	0.0
1/11/79	740	1.58	0.05	0.12	0.12	0.08	0.06	0.04	30.6	0.0	0.0	0.0	0.0	0.0
1/11/79	1245	12.00	2.29	1.44	1.14	0.95	0.82	0.63	1811.3	26.1	20.6	17.4	14.9	11.4
1/12/79	720	3.42	0.12	0.12	0.12	0.12	0.08	0.04	73.3	0.1	0.1	0.1	0.1	0.0
1/13/79	450	6.83	0.31	0.36	0.24	0.16	0.12	0.08	200.2	0.7	0.5	0.3	0.2	0.2
1/15/79	525	0.33	0.03	0.12	0.12	0.08	0.0	0.0	19.3	0.0	0.0	0.0	0.0	0.0
1/15/79	1250	1.08	0.06	0.12	0.12	0.09	0.08	0.06	36.7	0.0	0.0	0.0	0.0	0.0
1/19/79	2315	0.17	0.03	0.24	0.18	0.0	0.0	0.0	20.3	0.0	0.0	0.0	0.0	0.0
1/20/79	145	0.50	0.04	0.24	0.12	0.08	0.04	0.0	28.4	0.1	0.0	0.0	0.0	0.0
1/20/79	535	0.42	0.07	0.60	0.36	0.24	0.0	0.0	54.4	0.3	0.2	0.1	0.0	0.0
1/20/79	1055	0.83	0.03	0.24	0.12	0.09	0.04	0.0	20.3	0.0	0.0	0.0	0.0	0.0
1/20/79	2205	1.42	0.03	0.12	0.06	0.04	0.02	0.02	18.3	0.0	0.0	0.0	0.0	0.0
1/21/79	655	0.83	0.10	0.60	0.36	0.12	0.04	0.0	72.7	0.4	0.3	0.1	0.0	0.0
1/21/79	940	0.92	0.03	0.12	0.06	0.04	0.02	0.0	19.3	0.0	0.0	0.0	0.0	0.0
1/21/79	1210	0.17	0.07	0.48	0.42	0.0	0.0	0.0	55.5	0.3	0.2	0.0	0.0	0.0
1/21/79	1840	0.67	0.06	0.24	0.12	0.12	0.08	0.0	43.7	0.1	0.0	0.0	0.0	0.0
1/21/79	2155	0.17	0.05	0.48	0.30	0.0	0.0	0.0	38.5	0.2	0.1	0.0	0.0	0.0
1/22/79	200	2.42	0.39	0.60	0.44	0.36	0.22	0.18	274.0	1.6	1.3	1.0	0.6	0.5
1/22/79	610	1.00	0.03	0.12	0.06	0.04	0.04	0.03	18.3	0.0	0.0	0.0	0.0	0.0
2/ 4/79	430	0.58	0.09	0.36	0.30	0.15	0.16	0.0	63.7	0.2	0.2	0.1	0.1	0.0
2/ 4/79	740	0.25	0.09	0.60	0.24	0.35	0.0	0.0	71.3	0.4	0.2	0.3	0.0	0.0
2/ 4/79	900	0.42	0.03	0.12	0.06	0.04	0.0	0.0	18.3	0.0	0.0	0.0	0.0	0.0
2/ 4/79	1225	7.08	1.32	0.96	0.84	0.60	0.44	0.27	773.1	7.4	6.5	4.6	3.4	2.1
2/ 5/79	225	2.50	0.12	0.24	0.18	0.15	0.10	0.06	75.3	0.2	0.1	0.1	0.1	0.0
2/ 5/79	545	7.92	0.75	0.44	0.36	0.28	0.18	0.17	525.4	2.5	1.9	1.5	0.9	0.9
2/ 5/79	1740	1.33	0.07	0.12	0.06	0.04	0.06	0.05	42.8	0.1	0.0	0.0	0.0	0.0
2/ 7/79	1605	0.83	0.04	0.12	0.12	0.09	0.06	0.0	24.4	0.0	0.0	0.0	0.0	0.0
2/ 9/79	1250	1.17	0.09	0.36	0.18	0.16	0.12	0.07	53.6	0.2	0.1	0.1	0.1	0.0
2/ 9/79	1655	2.33	0.23	0.49	0.36	0.32	0.16	0.12	169.2	0.8	0.6	0.5	0.3	0.2
2/10/79	640	3.42	0.82	1.50	1.50	1.24	1.02	0.55	700.3	12.6	10.5	9.0	7.1	3.9
2/10/79	1855	0.83	0.04	0.24	0.12	0.08	0.06	0.0	25.4	0.1	0.0	0.0	0.0	0.0
2/11/79	1415	0.17	0.03	0.24	0.18	0.0	0.0	0.0	20.3	0.0	0.0	0.0	0.0	0.0
2/18/79	410	3.58	0.08	0.12	0.06	0.05	0.04	0.03	48.9	0.1	0.0	0.0	0.0	0.0
2/18/79	2040	0.92	0.04	0.12	0.12	0.09	0.06	0.0	24.4	0.0	0.0	0.0	0.0	0.0
2/19/79	245	5.92	0.64	0.36	0.36	0.32	0.28	0.25	423.3	1.5	1.5	1.4	1.2	1.1
2/19/79	1400	3.75	0.20	0.24	0.12	0.12	0.10	0.05	124.2	0.3	0.1	0.1	0.1	0.1
2/20/79	1725	0.75	0.03	0.12	0.06	0.04	0.04	0.0	18.3	0.0	0.0	0.0	0.0	0.0
2/20/79	1905	2.09	0.33	0.60	0.36	0.40	0.26	0.16	219.2	1.3	0.8	0.9	0.6	0.4
2/20/79	2250	3.92	1.72	2.88	1.50	1.64	0.88	0.67	1615.5	46.5	24.2	26.5	14.2	10.8
2/21/79	725	0.17	0.09	0.84	0.54	0.0	0.0	0.0	76.6	0.6	0.4	0.0	0.0	0.0
2/21/79	1200	0.50	0.20	1.20	0.78	0.60	0.40	0.0	173.6	2.1	1.4	1.0	0.7	0.0
2/21/79	2230	0.08	0.05	0.60	0.0	0.0	0.0	0.0	42.1	0.3	0.0	0.0	0.0	0.0
2/22/79	45	2.67	0.15	0.60	0.36	0.24	0.16	0.10	105.2	0.6	0.4	0.3	0.2	0.1
2/24/79	1055	1.75	0.09	0.48	0.30	0.24	0.14	0.08	63.0	0.3	0.2	0.2	0.1	0.1
3/ 8/79	1520	2.83	0.11	0.12	0.06	0.09	0.06	0.05	67.2	0.1	0.0	0.1	0.0	0.0
4/ 1/79	1405	0.25	0.03	0.12	0.12	0.12	0.0	0.0	18.3	0.0	0.0	0.0	0.0	0.0
4/12/79	1600	0.25	0.04	0.36	0.18	0.16	0.0	0.0	29.2	0.1	0.1	0.0	0.0	0.0
4/14/79	1355	0.50	0.03	0.36	0.24	0.20	0.18	0.0	63.7	0.2	0.2	0.1	0.1	0.0
4/14/79	1530	0.83	0.09	0.36	0.24	0.16	0.04	0.0	59.7	0.2	0.1	0.1	0.0	0.0
4/16/79	200	1.08	0.09	0.36	0.24	0.16	0.08	0.08	61.7	0.2	0.1	0.1	0.0	0.0
4/16/79	720	1.25	0.13	0.24	0.18	0.16	0.12	0.12	83.4	0.2	0.2	0.1	0.1	0.1
4/17/79	320	0.17	0.04	0.24	0.24	0.0	0.0	0.0	28.4	0.1	0.1	0.0	0.0	0.0
4/18/79	1240	1.50	0.24	0.84	0.48	0.32	0.30	0.22	187.8	1.6	0.9	0.6	0.6	0.4
4/22/79	1220	1.00	0.20	0.48	0.36	0.28	0.22	0.20	140.2	0.7	0.5	0.4	0.3	0.3
4/24/79	1055	0.25	0.06	0.35	0.18	0.24	0.0	0.0	43.4	0.2	0.1	0.1	0.0	0.0
5/ 3/79	445	0.83	0.12	0.36	0.24	0.20	0.12	0.0	82.8	0.3	0.2	0.2	0.1	0.0
5/ 3/79	730	0.42	0.03	0.12	0.12	0.09	0.0	0.0	19.3	0.0	0.0	0.0	0.0	0.0
5/ 4/79	740	0.50	0.05	0.24	0.18	0.15	0.10	0.0	32.6	0.1	0.1	0.1	0.0	0.0
5/10/79	1555	1.25	0.10	0.48	0.30	0.24	0.06	0.04	71.1	0.3	0.2	0.2	0.0	0.0
5/17/79	1420	1.08	0.09	0.44	0.36	0.32	0.16	0.08	67.0	0.3	0.2	0.2	0.1	0.1
5/26/79	1745	0.75	0.05	0.24	0.18	0.12	0.08	0.0	32.6	0.1	0.1	0.0	0.0	0.0
6/11/79	525	0.42	0.07	0.36	0.24	0.08	0.0	0.0	49.5	0.2	0.1	0.0	0.0	0.0
6/14/79	345	1.58	0.52	0.84	0.66	0.64	0.40	0.38	411.1	3.5	2.7	2.6	1.6	1.6
10/ 8/79	15	0.08	0.04	0.48	0.0	0.0	0.0	0.0	32.4	0.2	0.0	0.0	0.0	0.0
10/ 8/79	340	0.50	0.07	0.24	0.24	0.16	0.14	0.0	48.8	0.1	0.1	0.1	0.1	0.0
10/ 8/79	625	0.58	0.17	0.60	0.42	0.28	0.26	0.0	132.2	0.8	0.6	0.4	0.3	0.0
10/ 8/79	1745	0.50	0.08	0.60	0.30	0.20	0.16	0.0	65.2	0.4	0.2	0.1	0.1	0.0
10/ 8/79	1905	0.17	0.05	0.48	0.30	0.0	0.0	0.0	38.5	0.2	0.1	0.0	0.0	0.0

APPENDIX F

APPENDIX F

The Use of a Rainfall Simulator and Soil Loss

In an attempt to quantify crop cover effects under controlled conditions, the maize was planted in small plots and intercropped with 'kalo' and rose clover on July 21, 1979. All the plots were fertilized with ammonium sulfate applied at a rate of 95 kg N/ha. There were four replicates for each treatment consisting of: fallow; maize; maize + 'kalo'; maize + rose clover. The dimension of each plot was 2.53 x 0.76 m.

Simulated rainfall was applied with a 'Vee-Jet' nozzle at a rate of 353 mm per hour. The data collected are in the following units: runoff, liters per plot; sediment, grams per plot; C cover (maize canopy cover), percent; L cover (legume ground cover), percent; density, plants per square foot; moisture (antecedent soil moisture), percent; and slope, percent. Little can be concluded from the results (Table 36), probably due to the excessively high intensity of applied rainfall.

APPENDIX F

Table 37. Rainfall Simulator--Soil Loss and Runoff

	Plot No.	Runoff	Sediment C.	Cover L.	Cover	Density	Moisture	Slope
Storm 1. 21 Aug 79	1	66.5	3332.32	0	0	0	27.90	4.22
	2	66.5	2910.04	0	0	0	30.18	6.03
	3	86.5	1258.58	0	0	0	32.68	4.22
	4	78.5	3749.16	0	0	0	34.43	6.03
	5	9999.9	9999.99	35	0	0	999.99	2.41
	6	54.0	325.62	47	0	0	24.19	4.82
	7	65.0	2312.05	37	0	0	26.62	4.22
	8	77.5	615.35	54	0	0	31.89	5.42
	9	70.8	302.81	44	17	15	25.09	3.01
	10	59.0	246.03	40	17	14	30.13	4.82
	11	62.5	950.00	50	24	17	31.63	4.82
	12	72.5	516.93	50	14	13	35.29	4.82
	13	67.0	658.61	43	8	17	25.57	3.62
	14	66.5	370.41	40	43	21	35.69	6.03
	15	55.5	171.50	42	26	15	32.35	3.01
	16	70.5	352.50	23	37	24	33.51	3.62
Storm 2. 4 Sept 79	1	73.0	2061.52	0	0	0	0.0	
	2	80.2	1210.17	0	0	0	0.0	
	3	97.0	2672.35	0	0	0	0.0	
	4	85.0	1496.85	0	0	0	0.0	
	5	81.5	390.39	63	0	0	0.0	
	6	78.8	370.13	78	0	0	0.0	
	7	76.5	759.65	73	0	0	0.0	
	8	78.5	202.53	85	0	0	0.0	
	9	71.2	91.91	72	34	15	0.0	
	10	89.2	155.30	78	29	11	0.0	
	11	81.0	844.83	71	40	17	0.0	
	12	90.0	226.80	85	21	7	0.0	
	13	79.0	210.93	75	12	14	0.0	
	14	90.0	274.50	72	69	20	0.0	
	15	76.5	116.28	80	44	13	0.0	
	16	90.0	221.40	70	55	20	0.0	

Plots 1 -- 4: Fallow

5 -- 8: Maize

9 -- 12: 'Kalo'

13 -- 16: Rose clover

Table 37 (continued)

	Plot No.	Runoff	Sediment C.	Cover L.	Cover	Density	Moisture	Slope
Storm 3. 19 Sept 79	1	90.0	2519.10	0	0	0	32.09	
	2	80.5	3368.93	0	0	0	33.72	
	3	89.5	1418.58	0	0	0	32.79	
	4	89.5	2159.64	0	0	0	33.65	
	5	76.0	185.44	96	0	0	32.19	
	6	76.0	216.60	98	0	0	32.34	
	7	83.5	631.26	95	0	0	33.33	
	8	91.5	159.21	93	0	0	33.47	
	9	75.5	84.56	90	27	10	33.29	
	10	81.5	138.55	94	25	7	32.79	
	11	81.5	422.17	88	41	11	33.08	
	12	89.5	222.86	94	20	6	32.62	
	13	79.0	188.65	86	17	9	32.52	
	14	70.5	33.84	94	54	13	33.74	
	15	76.0	45.60	94	43	15	32.01	
	16	75.5	93.62	85	46	15	34.05	
Storm 4. 2 Oct 79	1	93.5	1651.21	0	0	0	34.48	
	2	94.2	2195.08	0	0	0	34.16	
	3	105.5	1465.40	0	0	0	34.52	
	4	103.0	2275.27	0	0	0	34.52	
	5	90.0	254.70	94	0	0	33.63	
	6	76.5	226.44	94	0	0	34.43	
	7	95.5	540.53	85	0	0	34.99	
	8	96.0	112.32	87	0	0	37.27	
	9	81.5	97.80	87	20	12	36.03	
	10	88.0	91.52	90	21	6	33.81	
	11	83.5	273.05	90	42	10	34.74	
	12	79.5	293.36	92	19	5	34.49	
	13	94.0	172.96	93	20	11	34.02	
	14	89.5	93.08	82	39	14	35.89	
	15	79.5	43.73	92	41	19	34.49	
	16	78.5	69.87	82	35	12	35.05	

Plots 1 -- 4: Fallow

5 -- 8: Maize

9 -- 12: 'Kalo'

13 -- 16: Rose clover

Table 37 (continued)

	Plot No.	Runoff	Sediment C.	Cover L.	Cover	Density	Moisture	Slope
Storm 5. 16 Oct 79	1	117.1	4287.03	0	0	0	28.23	
	2	79.5	1705.28	0	0	0	27.17	
	3	97.0	1264.88	0	0	0	31.46	
	4	93.5	900.41	0	0	0	31.26	
	5	90.0	284.40	93	0	0	30.31	
	6	71.5	455.46	90	0	0	32.23	
	7	82.2	257.44	75	0	0	30.94	
	8	77.5	254.98	81	0	0	31.33	
	9	92.5	125.80	86	25	10	30.25	
	10	104.2	192.77	86	21	6	31.48	
	11	77.5	208.48	91	48	10	31.17	
	12	75.2	215.97	89	28	6	32.16	
	13	97.0	427.77	93	16	9	29.60	
	14	90.0	133.20	74	27	11	29.21	
	15	64.5	34.19	88	38	19	27.52	
	16	72.5	165.30	77	40	9	30.39	
Storm 6. 30 Oct 79	1	116.4	1645.33	0	0	0	30.24	
	2	112.0	925.12	0	0	0	33.36	
	3	109.0	1400.65	0	0	0	33.24	
	4	103.5	1260.63	0	0	0	32.55	
	5	99.0	235.62	92	0	0	30.57	
	6	97.5	486.53	86	0	0	30.15	
	7	94.2	521.20	65	0	0	35.61	
	8	83.5	353.21	75	0	0	33.66	
	9	97.5	148.20	86	31	17	32.53	
	10	109.5	210.24	83	24	5	31.92	
	11	81.5	250.21	87	49	12	32.59	
	12	81.5	428.69	87	27	4	30.28	
	13	98.5	160.56	92	16	11	30.91	
	14	103.5	207.00	70	21	7	31.57	
	15	80.0	83.20	86	41	16	32.40	
	16	83.5	167.00	74	32	8	33.26	

Plots 1 -- 4: Fallow

5 -- 8: Maize

9 -- 12: 'Kalo'

13 -- 16: Rose clover

APPENDIX G

APPENDIX G

NO_3^--N in the Surface Runoff

The nitrogen treatments caused no detectable trend on the NO_3^--N in the runoff. In part, this may be due to the high nitrogen rates which can mask the small differences.

Increasing vegetative cover had an inverse effect on NO_3^--N in the runoff. The trends are: fallow > maize > maize + lotus > maize + trifolium. The legume plots had an average decrease of 26% NO_3^--N, in comparison to the fallow plots. The addition of maize cover caused an 11% decrease in NO_3^--N in comparison to fallow.

Nitrate losses from the maize-trifolium treatment were significantly different from fallow at all nitrogen rates (Table 38). The nitrogen rate of 380 kg N/ha showed a characteristic decrease for all vegetative treatments. It would be understandable if this happened in the maize or in the maize-legume plots; the plants could be at their optimum nitrate uptake, but this effect is also present in the fallow plots (Figure 10).

Overall, the amount of nitrate lost in the surface runoff is minimal. The fallow plot lost 1% of the applied N. This indicates that leaching losses for this soil may be more of a problem. In contrast, Lal (1976) found that the fallow plots on an Alfisol at a 5% slope lost 8.9 kg N/ha at a fertilizer rate of 120 kg N/ha. Burwell et al. (1975) found that temperate soils (Barnes loam) lost 3.4 kg N/ha from the fallow plots. In other studies of tropical soils, Barnett et al. (1972) applied 134 kg N/ha and simulated the rainfall (6.4 cm/hr) on the following soils: Humatas clay, Juncos silty, and Panduras silt loam. The amount of nitrates recovered was low, so the results reported were mostly ammonia-N. The amounts of nitrogen found in the runoff were: 0.41, 9.96, and 0.35 kg/ha for Humatas clay, Juncos silt clay, and Pandura silt loam, respectively.

APPENDIX G

Table 38. Analysis of Variance Table for NO_3^--N in the Surface Runoff

Source	df	MS	
Subplots	47	331946	
Block	3	850814	
Nitrogen	2	1113008	N.S.
Mainplot Error	6	435209	
Cover	3	1079883	*
Cover x Nitrogen	6	92414	N.S.
Subplot Error	27	163615	

CV = 20.7%

N.S. = nonsignificant at p=0.05

* = significant at p=0.05

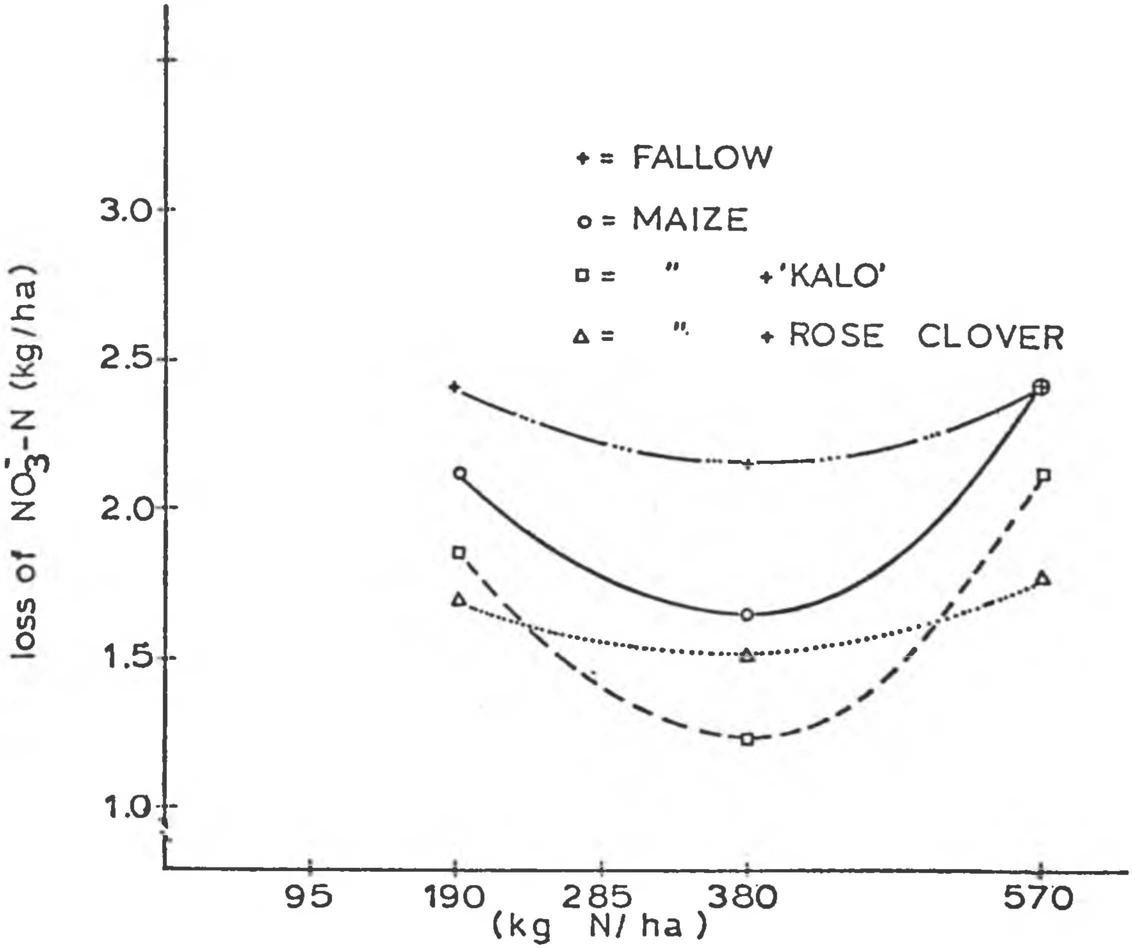
APPENDIX G

Table 39. Effect of Vegetative Cover and Nitrogen Rates on NO_3^--N (kg/ha) in the Surface Runoff

Vegetative Cover	Nitrogen Rates (kg/ha)			Vegetative Cover Means
	190	380	570	
Fallow	2.42 a	2.15 a	2.40 a	2.32 a
Maize	2.12 ab	1.67 ab	2.41 a	2.07 ab
Maize + 'kalo'	1.86 ab	1.32 b	2.12 ab	1.77 bc
Maize + rose clover	1.70 b	1.51 b	1.78 b	1.66 a
N rate means	2.02	1.66	2.18	

Means with the same letter within the columns are not significantly different at p=0.05 using Duncan's Multiple Range Test.

Figure 10. Effect of N Rates and Vegetative Cover on NO_3^- in the Runoff



APPENDIX H

APPENDIX H

Table 40. Air Dry Weight and Percent Leaf N for Selected Intercropped Legume Plots

	Air Dry Wt. kg/ha	% Leaf N
'Kalo'	2825.5	3.27
	2475.7	2.99
	3498.3	2.88
Rose clover	6350.7	2.54
	10145.0	2.91
	8718.8	2.72

APPENDIX I

APPENDIX I

Table 41. Average Weekly Solar Radiation (Langley) and Temperature From Benchmark Soils Project Located in Mauna Loa, Molokai

		Solar Rad.	Temperature C	
Date	Week	(Langley's)	Max	Min
Nov 1978	48	454.2	28.0	18.5
Dec 1978	49	255.4	24.8	20.14
	50	377.6	24.5	19.2
	51	401.0	23.4	18.6
	52	388.7	24.0	17.1
Jan 1979	2	159.0	24.8	16.2
	3	377.0	21.4	17.1
	4	456.0	22.1	18.3
	5	-	23.7	15.7
	6	248.6	22.3	18.0
	7	384.9	22.1	17.4
	8	287.4	24.0	19.4
	9	503.9	25.7	19.0
	10	453.6	25.7	17.5
	11	525.5	26.3	16.4
	12	559.2	25.0	17.0
	13	513.2	25.7	15.7
	14	629.3	25.4	20.0
July 1979	25	635.5	28.8	20.3
	26	663.2	29.4	20.9
	27	583.3	28.5	19.8
	28	646.8	30.5	20.1
	29	631.1	30.4	20.5
	30	577.1	29.4	20.4
	31	585.6	29.8	20.5
	32	557.3	31.0	20.1
	33	512.5	30.5	21.1
	34	531.1	30.4	20.1
	35	528.7	30.5	21.0
	36	551.0	30.2	21.8
	37	575.8	31.1	20.4
	38	525.9	30.8	20.3

LITERATURE CITED

LITERATURE CITED

Agboola, A. A. and A. A. Fayemi. 1971. Preliminary trials on the intercropping of maize with different tropical legumes in Western Nigeria. J. Agric. Sci. 77:219-225.

Aina, P. O., R. Lal, and G. S. Taylor. 1976. Soil and crop management in relation to soil erosion in the rainforest region of Western Nigeria. Symposium Proceedings of the National Soil Erosion Conference. May 25-26, 1976. Lafayette, Indiana.

________ 1979. Effects of vegetal cover on soil erosion on an Alfisol. Chapt. 8.6. Pp. 501-508. In Soil Physical Properties and Crop Production in the Tropics. Ed. Lal and Greenland.

Ayres, A. S. and H. H. Hagihara. 1952. Available phosphorus in Hawaiian soil profiles. The Hawaiian Planter's Record, Vol. 54:81-99.

Azih, A. 1978. Effect of plant density and nitrogen fertilization on yields and mineral constituents of two maize varieties grown in Hawaii. Unpublished master's thesis. University of Hawaii.

Barnett, A. P., J. R. Carreker, F. Abruna, W. A. Jackson, A. E. Dooley, and J. H. Holladay. 1972. Soil and nutrient losses in runoff with selected cropping treatments on tropical soils. Agron. J. 64:391-395.

Baver, L. D. 1956. "Soil Physics." 3rd Edition, Wiley, New York, New York.

Bertoni, J., W. E. Larson, and W. D. Shrader. 1958. Determination of infiltration rates on Marshall silt loam from runoff and rainfall records. Soil Sci. Soc. of Amer. 22:571-574.

Beutner, E. L., R. R. Gaebe, and R. E. Horton. 1940. Sprinkled-plot runoff and infiltration experiments on Arizona desert soils. Trans. Am. Geophys. Union 21:550-558.

Black, C. A. 1965. Methods of Soil Analysis. Agron. No. 9. American Agron. Soc. Madison, Wis.

Borst, H. L., A. G. McCall, and F. G. Bell. 1945. USDA Tech. Bull. 888.

Bryant, J. C. and C. S. Slater. 1948. Iowa State Coll. J. Sci. 22:269-312.

Burwell, R. E., D. R. Timmons, and R. F. Holt. 1975. Nutrient transport in surface runoff as influenced by soil cover and seasonal periods. Soil Sci. Soc. Amer. Proc. 39:523-528.

Carrecker, J. R. 1976. Unpublished data from Amer. Society of Agronomy, Special Publication No. 27. Multiple Cropping. P. 321.

Chapman, H. D. 1965. Cation Exchange Capacity. Pp. 891-900. In Methods of Soil Analysis. Ed. C. A. Black. Agron. No. 9. Agronomy Society of America.

Dalal, R. C. 1974. Effects of intercropping maize with pigeon peas on grain yield and nutrient uptake. Expl. Agric. 10:219-224.

Dangler, E. W., S. A. El-Swaify, and A. P. Barnett. 1976. Erosion losses from Hawaiian soils under simulated rainfall. Research Bulletin 181. Hawaii Agric. Exper. Station. University of Hawaii.

El-Swaify, S. A. 1977. Susceptibilities of certain tropical soils to erosion by water. Pp. 71-77 in D. J. Greenland and R. Lal, eds., Soil Conservation and Management in the Humid Tropics. John Wiley and Sons, Chichester.

________ and L. R. Ahuja. 1976. Quality trends for waters. Harold L. Lyon Arboretum, 1974. HAES, Coll. Tropical Agric. University of Hawaii. Departmental Paper 39.

________, E. W. Dangler, C. L. Armstrong. 1981. Soil Erosion by Water in the Tropics: A State of the Ark. US Agency for International Development (AID/CSD-2833).

Elwell, H. A. and M. A. Stocking. 1976. Vegetal cover to estimate soil erosion hazard in Rhodesia. Geoderma 15:61-70.

Engelstad, O. P. and W. D. Shrader. 1961. The effect of surface soil thickness on corn yields: II As determined by an experiment using normal surface soil and artificially-exposed subsoil. Soil Sci. Soc. of Amer. Proc. 25:497-499.

Felipe-Morales, F., R. Meyer, C. Alegre, and C. Vittorelli.

1979. Losses of water and soil under different cultivation systems in two Peruvian locations, Santa Ana (Central Highlands) and San Ramon (Central High Jungle), 1975-1976. Pp. 489-499 in R. Lal and D. J. Greenland, eds., Soil Physical Properties and Crop Production in the Tropics. John Wiley and Sons.

Fox, R. L. and E. J. Kamprath. 1970. Phosphate sorption isotherms for evaluating the phosphorus requirements of soils. Soil Sci. Soc. of Amer. Proc. 34:902-907.

Helwig, J. 1978. SAS Introductory Guide. SAS Institute, Cary, North Carolina.

Horner, W. W. and L. C. Lloyd. 1940. Infiltration-capacity values as determined from a study of an eighteen-month record at Edwardsville, Illinois. Trans. Am. Geophys. Union 21:522-541.

Hudson, N. 1957. Erosion control research--Progress report on experiments at Henderson Research Station. 1953-1956. Rhodesian Agric. J. 54:297-323.

________. 1971. Soil Conservation. Cornell Univ. Press. Ithaca, N. Y., 320 pp.

Jones, J. B. and H. V. Eck. 1973. Plant analysis as an aid in fertilizing corn and grain sorghum. Pages 349-364 in L. M. Walsh and J. D. Beaton, eds., Soil Testing and Plant Analysis, rev. ed. Soil Sci. Soc. of Amer., Madison, Wisc.

Joy, R. 1977. Legumes and grasses for erosion control in sugarcane. Hawaiian Sugar Technologist's Conference--1977.

Kurtz, T., M. D. Appleman, R. H. Bray. 1946. Preliminary trials with intercropping of corn and clover. Soil Sci. Soc. of Amer. Proc. 11:349-355.

Kurtz, T., S. W. Melsted, R. H. Bray. 1952. The importance of nitrogen and water in reducing competition between intercrops and corn. Agron. J. 44:13-17.

Lal, R. 1976. Soil erosion on Alfisols in Western Nigeria, I. Effects of slope, crop rotation, and residue management. Geoderma 16:363-375.

________. 1976a. Soil erosion on Alfisols in Western Nigeria, II. Effect of mulch rates. Geoderma 16:377-387.

________. 1976b. Soil erosion on Alfisols in Western Nigeria, IV. Nutrient element losses in runoff and eroded sediments. Geoderma 16:403-417.

Lawes, D. A. 1966. Rainfall conservation and the yields of sorghum and groundnuts in Northern Nigeria. Samoru Res. Bull. No. 70.

Lee, C. H. 1978. Genetics of photoperiod sensitivity and seasonal effects in corn (Zea mays L.). Unpublished PhD. dissertation. University of Hawaii.

Mannering, J. V. and L. D. Meyer. 1963. The effects of various rates of surface mulch on infiltration and erosion. Soil Sci. Soc. of Amer. Proc. 27:84-86.

Mannering, J. V. and C. B. Johnson. 1969. Effect of crop row spacing on erosion and infiltration. Agron. J. 61:902-905.

Moe, P. G., J. V. Mannering, and C. B. Johnson. 1967. Loss of fertilizer nitrogen in surface runoff water. Soil Sci. 104(6):389-394.

Mueller-Dombois, D. and H. Ellenburg. 1974. Aims and Methods of Vegetative Ecology. John Wiley and Sons, N. Y., N. Y., 547 pages.

Nicholaichuk, W., D. W. L. Read. 1978. Nutrient runoff from fertilized and unfertilized fields in Western Canada. J. Environ. Qual. 7:542-544.

Nordquist, P. T. and G. A. Wicks. 1974. Establishment methods for alfalfa in irrigated corn. Agron. J. 66:377-380.

Pendleton, J. W., J. A. Jacobs, F. W. Slife, and H. P. Bateman. 1957. Establishing legumes in corn. Agron. J. 49:44-48.

Romkens, M. J. M., D. W. Nelson, and J. V. Mannering. 1973. Nitrogen and phosphorus composition of surface runoff as affected by tillage method. Jour. Environ. Qual. 2(2):292-295.

Siddoway, F. H. and A. P. Barnett. 1976. Water and wind erosion control aspects of multiple cropping, pp. 317-335. In Multiple Cropping. American Society of Agronomy. Special Publication No. 27.

Singer, M. J. and J. Blackard. 1977. Evaluation of wild oat straw as a soil erosion retardant using simulated rainfall. Agron. J. 69:811-814.

Sreenivas, L., J. R. Johnson, and H. O. Hill. 1947. Some relationships of vegetation and soil detachment in the erosion process. Soil Sci. Soc. of Amer. Proc. 12:471-474.

Stout, B. A. 1965. Soil erosion by water, some measures for its control on cultivated lands. FAO Agric. Dev. Paper No. 81. FAO, Rome.

USDA Soil Conservation Service. 1976. Soil Survey Laboratory Data and Descriptions for Some Soils of Hawaii. Soil Survey Investigations Report No. 29.

White, A. W., A. P. Barnett, and W. A. Jackson. 1967. Nitrogen fertilizer losses in runoff from cropland tested. Crops and Soils 19(4):28.

Wilkinson, G. E. 1975. Canopy characteristics of maize and the effect on soil erosion in Western Nigeria. Trop. Agric. 52:289-297.

Wischmeier, W. H. and D. D. Smith. 1978. Predicting Rainfall Erosion Losses--A Guide to Conservation Planning. USDA Agric. Handbook No. 537.

Woodburn, R. 1944. Reduced loss of soil, less runoff when mulch used. Miss. Agric. Exp. Stn., State Coll., Miss., Farm Research 6(8):7.